THE

ELECTRICAL REVIEW.

VOL. LII. MAY 8, 1903. No. 1,328.

"ELECTRICAL REVIEW."

Vol. LII.] CONTENTS: May 8, 1903. [No. 1,328.

	Page
Electric Railway Traction	765
Company and Consumer	767
Parliamentary	768
Legal	771
Correspondence	777
Business Notes	779
Power Transmission in Greece (*illustrated*)	785
New Plant for Power Stations (*illustrated*)	788
Electricity Supply Accounts	793
City Notes	794
Stocks and Shares	796
Share List of Electrical Companies	797
Market Quotations	798
Electric Tramway and Railway Traffic Receipts	798
Metal Market.—Fluctuations in April	799
South African Notes	799
Electric Welding in Dynamo Construction (*illustrated*) ...	799
Institution of Electrical Engineers:—	
Manchester Section	800
Royal Commission on London Traffic	801
Electrical Power on Railways	802
Notes on Motor-Starting Switches: A Criticism	802
Independent Air Pumps and Condensers	803
The Electrical Possibilities of a Coal Mine	804
The Mosely Industrial Commission	805
Oscillatory Electric Sparks (*illustrated*)	807
Prof. J. J. Thomson on Radium	807
New Patents Applied For, 1903	808
Published Specifications	808

THE

UNIVERSAL ELECTRICAL DIRECTORY

1903 Edition

NOW READY.

Price 10s. Post Free.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGREKAY, LONDON." Code, A B C.

Telephone No. 933 Holborn.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, AND HAS

BY FAR THE LARGEST CIRCULATION

of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—In Great Britain, Post Free per Year, 19s. 6d. To all other countries, per Year, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s. 9d.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can now be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street, Paris: VEUVE J. BOYVEAU, 22, Rue de la Banque. Berlin: ASHER & Co., 13, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

ELECTRIC RAILWAY TRACTION.

LAST week an important Government Bill was introduced by Mr. Gerald Balfour, which is intended to facilitate the introduction of electric traction on our railways; the Bill, of which some detailed particulars are given by a legal contributor on another page of this issue, contains several clauses, but the one which presents the greatest interest is Clause 1, whereby, amongst other things, the Board of Trade can make an order, which, on coming into operation, shall have effect as if it had been enacted by Parliament. By this means, where railway companies are considering the introduction of electricity on their lines, a considerable amount of time and money would probably be saved, as, instead of having to get an Act of Parliament, it would only be necessary to satisfy the Board of Trade.

The proposed Bill treats of a subject which is actually engaging the minds of many of the boards of our railway companies, as is shown by the fact that several of them are already applying to Parliament this year for powers to do everything that may be necessary to employ electricity on their whole system, should they think fit so to do.

The first clause of the Bill sets out at length several different ways which, in the opinion of the Board of Trade, would facilitate the introduction of electric traction on railways; and these ways by their very nature are of interest.

The Bill, however, is not exclusively connected with electric traction, but with the use of electricity for any purpose by railways. Our railway authorities have already realised how useful electricity is, and there are several companies who have put up electric power stations and operated their crane and capstan installations electrically. The North-Eastern Railway Co. has already done this at Middlesbrough, and the L.B. & S.C. Railway is completing a preliminary experimental station for the same purpose at Deptford Wharf.

The Bill suggests that in some cases railway companies, in order to avoid increasing their capital, may find it advantageous to make arrangements either to purchase power from existing electrical undertakings, or to subscribe to, or take part in, a separate company, in order to facilitate the supply of electricity for power purposes.

One of these two methods has already been adopted to a certain extent by the North-Eastern Railway in the case of all the electric lines which are now being equipped between Newcastle and Tynemouth. The railway company has made arrangements with the Electric Power Co. to supply high-pressure polyphase currents to sub-stations owned by the North-Eastern, where the current is converted into continuous current at 500 volts.

The other method is more or less that which was adopted in the case of the Metropolitan District Co. in London, where one large power station at Chelsea Creek, which will contain 55,000-KW. generator capacity, but which will

be able to do 50 per cent. overload for two hours, will supply electric current to the Metropolitan District Railway, to the Charing Cross, Euston and Hampstead Railway, the Brompton and Piccadilly Circus Railway, the Great Northern and Strand Railway, the Baker Street and Waterloo Railway, and the Great Northern, Piccadilly and Brompton Railway, and probably also to the Tilbury and Southend Railway.

When this plant was first installed an attempt was made to come to an arrangement to supply electricity to the Metropolitan Railway also, but this was unsuccessful.

There is no doubt that a great deal can be done in the way of facilitating the use of electricity by railways. We know of a case where a very large goods yard is owned by two railway companies, one of which is considering the installation of an electric power plant to light and operate the various machinery, such as cranes, capstans, lifts, &c. The other railway company would be very glad to purchase power at terms which would be advantageous to both companies, but at present, to enable this to be done, an Act of Parliament would have to be obtained.

The Bill which is being introduced by Mr. Gerald Balfour is a very good sign, and bears out the opinion which we have so often expressed in these columns as regards the probable introduction in the near future of electric traction on our railways.

That the application will first be made on suburban and interurban lines is clear; we do not see any reason to change our belief that in this country at least, as far as main line traffic goes, the introduction of electric traction is somewhat remote, but the subject is occupying the attention of many eminent engineers, and we hopefully await the results of their investigations.

There is one important point to which we would refer in conclusion, and on which we hope to touch again, namely, the enormous capital expenditure which will have to be incurred, in any case by those railway companies which enter London, in connection with additional terminal facilities, as at present the accommodation of most of our railway companies in this direction is insufficient to enable them to properly handle their main line long-distance traffic. If electric traction were introduced the suburban traffic would certainly be doubled, if not trebled, and in order to get the best financial results from both, and satisfy the requirements of the travelling public, they would in all probability have to be operated in an entirely different way from the methods that at present obtain. Should the introduction of electric traction on a large scale be realised, the short-distance and long-distance traffic may have to be entirely separated, and not only have separate terminal stations, as has been done in the case of the Boston central station in America, but also each branch of traffic be under entirely separate and independent management.

There is much to be said on this subject which space does not permit of now, and we hope in the near future to return to it at greater length.

Ratepayers and Municipal Trading.

We publish in another column a full report of the case of the Attorney-General *v.* The Mayor, &c., of Barnstaple, which would seem to show that ratepayers are in some districts fully prepared to check the unlawful aspirations of the local authority. It appears that in the year 1900 the defendant Corporation obtained from the Board of Trade a provisional order enabling them to supply electricity within the borough. They also obtained power to borrow £21,600 on the security of the rates, for the purpose of executing the works authorised by the provisional order. They thereupon proceeded to erect a generating station and to lay mains. In the summer of last year, however, they circularised the ratepayers and gave out that they were prepared to supply electric fittings and fit them up in private houses, and in pursuance of this notice did, in fact, spend a portion of the money which they had borrowed in carrying out these works. Two ratepayers, with the leave of the Attorney-General, brought an action to restrain them from so doing, on the ground that it was *ultra vires*. The defendants argued that they were entitled to supply fittings in accordance with the general law of the land. As a result of the litigation, however, they consented to the following order:—"The Corporation undertake not to do any further installations for customers or to expend any further moneys on private installations except in pursuance of obligations already entered into." They were also directed to pay the costs of the action. It will be seen that the Corporation here attempted to do that which the County Council sought power to enable the Metropolitan Borough Councils to do by their "Omnibus" Bill, which was presented to Parliament a few weeks ago. The County Council's endeavour, as we stated at the time, was defeated after discussion of the matter in the House of Commons. The Barnstaple case proves to demonstration that powers of this kind cannot be exercised without the express authority of Parliament; and the L.C.C. defeat shows that that authority is not easy to obtain.

The Electrical Trades Union.

It must be highly gratifying to the electrical firms in the Manchester district to learn from a circular just sent round to them by the above trades union, that approval by any firm of the rules issued by the Union will entitle such firm to a place in the Union's list of "fair firms"! We are in sympathy with everything that is good in trades unionism, from which it need not be inferred that our sympathies extend very far. Rule No. 5 is to the effect that the minimum rate of wages for wiremen is to be 8½d. per hour, and the circular referred to adds that "a standard rate of pay will have a tendency to prevent unfair competition between employers," doing away with scamped labour and ensuring a good class of work. Rules 1 and 2 seek to regulate the number of hours of work and rates for overtime. A week's work shall consist of 53 hours, made up of five days of 9½ hours and one of 5½ hours. The first two hours of overtime in one day to rank as time and a quarter, the second two as time and a half, and everything beyond that until starting time next day to be counted as double time. Each day to stand by itself. "No member to work overtime unless absolutely necessary, while members in the district are unemployed." On the above basis, if a man works from 6 o'clock on one morning till 6 o'clock on the following morning, taking 3½ hours for meals, he will put in 20½ hours actual work, for which he will claim 29 hours' pay. If he continue working through the day, he may do so at ordinary rates, and at the end of the week, having lost no quarters, he draws for 72½ hours. He may take a day off, bringing his actual working hours for the week to 54½ or 1½ hours overtime, but he draws for 63; or he may lose four quarters, bringing his actual week's work to 54 hours, or 1 hour's overtime, yet he would draw for 62½ hours.

Many firms object to this mode of reckoning, considering that each week, not each day, should stand by itself before

adding overtime. It is not an uncommon thing for a man to lose a quarter or two, and then ask his chargeman to let him work a little overtime to make up for it. We have no sympathy with attempts to standardise rates of pay or to restrict hours of labour, and we think the Electrical Trades Union would be better employed in making some real attempt to raise the standard of workmanship, leaving the men to settle their wages and make the best terms they can.

Speaking Flames.

Simon, Duddell and others have shown how the electric arc can be made to emit articulate speech (see Electrical Review, March 25th, 1898, p. 393), and now two Russian investigators have discovered that ordinary flames, such as a Bunsen flame, the flame of a paraffin lamp, or even the flame of a candle, can be made to speak. Gabritschewski and Batschinski, the discoverers of this curious phenomenon, describe their method of proceeding in the *Annalen der Physik*, Vol. 11, p. 223. From both poles of an induction coil short leads were taken to insulated Bunsen burners, paraffin lamps, or to short candle ends. A battery and microphone, capable of taking currents up to 4 amperes, were placed in shunt in the primary circuit of the coil. The distance from the microphone to the flame was about 30 metres. The flames gave an excellent rendering of singing, whistling and even speech. The essential condition for success in the experiment is to have sufficiently great changes of potential at the flame electrodes. The flame sings louder when there is a wire between two flames connected respectively to the two poles of the induction coil.

Workmen's Compensation.

Amongst the batch of workmen's compensation cases which have recently come before the Court of Appeal, there is one to which we think attention should be specially directed. We refer to the case of Stevens *v.* General Steam Navigation Co., in which it came to light that the scope of the Act of 1897 was considerably extended by the Factory Act, 1901. It may be remembered that by a vicious system of "legislation by reference," the word "factory," as used in the Act of 1897, was given the meaning attached to it in the Factory Act, 1895. That measure was repealed and re-enacted by the Act of 1901; but, by the definition clause of the Act of 1901, the term "factory" is given an extended meaning. Thus Sec. 104 of the Act of 1901 alters the definition so as to include the loading or unloading of any vessel in any dock, harbour, or canal. Under the Act of 1895 these provisions merely extended to vessels in *docks*. In the case under notice, a claim was made for compensation for injuries sustained by a man who was working in a ship which was lying in the fairway of the Thames. It was argued that inasmuch as the definition of the term factory has been extended by the Act of 1901, a claim could be made under the Workmen's Compensation Act for injuries sustained by a man while employed in repairing a ship in the Thames, that being a harbour within the definition contained in the Merchant Shipping Act. It was argued on the part of the defendants that, although the Factory Act, 1901, was undoubtedly substituted for that of 1895, the effect of the present contention would be to extend the operation of the Compensation Act. This, it was urged, could not have been the intention of the Legislature. This view, however, did not commend itself to the Court, which held that the applicant was entitled to succeed. Although the settlement of claims under the Workmen's Compensation Act has been largely entrusted to insurance companies, employers must watch any extension of its operation with considerable interest. Indeed, signs are not wanting to show that insurance companies may demand increased premiums, as the risks are turning out to be greater than originally contemplated. The case under notice brings to light a very important extension of these risks.

COMPANY AND CONSUMER.

[BY OUR LEGAL CONTRIBUTOR.]

The editors of the Electrical Review have received a large number of queries relating to the legal questions which arise between company and consumer. It seems that the meter is a constant source of trouble; while difficulties occasioned by the alteration of the company's system of supply are of frequent occurrence. In these circumstances, a few notes dealing with the law upon the subject, illustrated by references to recent cases, may be found useful to readers of the Review.

Every consumer should understand that a mere demand does not entitle him to be supplied with electrical energy. The Act of 1899, and all provisional orders to which that Act does not apply, contain the conditions which have to be observed by any owner or occupier requiring a supply of energy. After serving a notice specifying the premises, the maximum power required, and the day upon which the supply is required to commence, the intending consumer must enter into a written contract, if required by the undertakers, to receive and pay for a supply for at least two years, of such an amount that the payments to be made for the supply at the rate of charge for the time being charged by the undertakers for a supply of energy to ordinary consumers within the area of supply, shall not be less than 20 per cent. per annum on the outlay incurred by the undertakers in providing any electrical lines required to be provided for the purposes of the supply; and if required by the undertakers the consumer must also give security.

The first regulation to which it is necessary to draw attention is that which prescribes a limit of distance within which a supply company may be compelled to lay communicating wires. So long as the consumer's premises are within 60 ft. of the company's mains he is entitled to be connected up free of charge. Before making any application for a supply of energy, all consumers should therefore take care to ascertain the distance of the nearest main belonging to the supply company.

The tenant of premises when he signs an application form for connection to the company's main agrees to take a supply of electricity at specified rates and for specified purposes. The contract frequently contains some clause to the effect that "for any quantity up to, say, 20 units in each quarter, the company may charge, say, 13s. 4d." In these circumstances, suppose the consumer uses no electricity at all, can he be made to pay the minimum of 13s. 4d.? In other words, do the words "up to 20 units" include "0 units." This question was addressed to the Editors some time since, and the view was expressed that the company is entitled to charge the minimum reserved by the contract, even though the consumer does not have his house wired. The Electric Lighting Acts clearly contemplate that the supply company will have to make a certain capital outlay in order to meet the demands of consumers. The necessity for that outlay is in no degree diminished by the fact that a particular consumer does not elect to avail himself of his full rights. In the circumstances, it is conceived that the minimum rent must be paid, although no current is used. The view so expressed was confirmed by the judgment of a county court judge in a recent case.* There an electric lighting company installed the electric light for a customer who signed an agreement to pay 10s. a quarter for the meter for three years. Afterwards the customer discontinued taking the light, and paid what was due. After a lapse of two quarters the company brought an action for two quarters' meter rent. Judge Emden, at the Lambeth County Court, gave judgment for the plaintiffs, but without costs. A similar conclusion was come to in the High Court in the case of London E.S. Corporation *v.* Priddis (1901), 18 T.L.R., 64.

The accuracy—or, rather, the finality—of a meter register is a matter which sometimes comes before the Courts for consideration. As a general rule the register is regarded as conclusive. Indeed, it is declared by the Electric Lighting (Clauses) Act, 1899, Sec. 57, that the

* South London E.S. Corporation *v.* Gouldstein, Elec. Rev., October 10th, 1902, p. 618.

register of the meter is conclusive evidence, in the absence of fraud, of the value of the supply ; but provision is made for a reference of any disputes which may arise as to the accuracy of the meter, to an electrical inspector. In a case which was heard last year in the City of London Court, his Honour Judge Rentoul refused to be guided by the meter register. It appeared that the City of London Electric Lighting Co. sued a consumer for the sum of £3 1s. 10d., being a quarter's supply of electricity. The defendant objected that the meter was incorrect. He was only able to prove that it was inaccurate by showing that during the previous five years the amounts paid by him for the corresponding quarter were £1 18s. 6d., £1 1s., 16s. 10d., and 16s. respectively. He paid into Court the sum of £1 3s. 6d., alleging that this was sufficient. The learned judge said that the company could not sustain their claim in the face of the evidence, and he accordingly gave judgment for the defendant. The above case seems to show that an electric meter will not always be regarded as infallible in a Court of Justice.

A question sometimes arises as to the right of a consumer who obtains a supply of electricity at "motor" rates to transform it by means of a motor-generator and use it for lighting purposes. In view of the great difference which is made between "lighting" and "motor" charges, it will be economical to adopt this course in some cases. It is obvious, however, that by dealing in this way with a supply company, the consumer obtains an unfair advantage. Thus, one of the reasons why the company can afford to supply current for motive purposes at lower rates is that motors are, for the most part, driven during the day, when the "lighting load" at the central station is reduced to a minimum. It is obvious that the consumer who used a motor-generator would do so at a time when he required to light his premises, with the result that there would be a loss to the company. It is submitted that the use of a motor-generator is contrary to the spirit, even if it is not contrary to the letter, of the contract which is usually drawn up between company and consumer for supply at low rates for motive purposes.

With regard to the pressure at which the company is entitled to supply electricity, it would seem that the regulations drawn up by the Board of Trade in 1901 are sometimes lost sight of. As a general rule, the consent of the consumer must be obtained before there can be any alteration in the pressure at which he receives his supply. The regulations now provide that where the consumer withholds his consent after the undertakers have offered to comply with the general terms and conditions imposed by the local authority, and, if not required to do so under those terms and conditions, also to pay the reasonable cost of, and incidental to, the change (including compensation for any loss or damage incurred in consequence of the change), the undertakers may appeal to the Board of Trade, and that Board may, if they think fit, give their consent to the change on such terms and conditions as they impose, and the consent of the Board so given shall for the purpose of the regulation have the same effect as the consent of the consumer.

PARLIAMENTARY.

City and North-East Suburban Electric Railway.

On Wednesday, April 29th, Mr. Cuningham continued his evidence, and in answer to Mr. Pember (for the Great Eastern) said that the weight of the trains on the Central London Railway was 98 tons for the seven coaches and 42 tons for the locomotive. The weight would be reduced when the multiple unit system was adopted. The weights were 140 and 118 respectively.

Mr. E. J. Halsey, J.P., whose name is in the Bill as a director, said that the remaining directors were Mr. J. H. Buxton, Mr. Montague Craddock, Mr. J. H. Lukach, Hon. R. Parker, the Hon. Wilfred Stamforth, Mr. C. J. Lewis Stewart and Mr. H. W. Wack.

Sir Ralph Littler, K.C., asked Witness to what extent the promoters would be prepared to support the line financially. Witness was not prepared to answer that question, but said that there was every prospect of the money being found. He was aware that the whole of the money would have to be subscribed before they could take land compulsorily.

Sir Ralph Littler: Were you aware when you promoted this Bill that the Great Northern and City were not able to raise their capital at par?—He was aware of that. He did not see any difficulty in the present case.

By Mr. Pember: Witness was director of 15 companies. He had been asked to be chairman of the new company. Mr. Pember then asked Witness if he saw any objection to the insertion of a clause requiring the money to be raised in one year.

The Chairman asked Witness if he knew the meaning of Mr. Balfour Browne's statement that financial support for the line was coming from the other side of the Atlantic. Witness understood that it meant that support would be forthcoming from a group of American financiers.

The Chairman: Do you think that within two years you would be likely to place the stock of the company before the public through the Stock Exchange at par?—Yes, subject to a reasonable amount of commission.

Mr. Hay, joint engineer with Sir Benjamin Baker, of the City and South London line, said he had examined the plan of the station at the Monument on the proposed line. With regard to the cross-over before the stations, the Board of Trade sanctioned that arrangement on the City and South London, and it had worked well for 13 years on that line. The service in that case was often of 2½ minutes' interval.

Mr. Cottrell, general manager of the Liverpool Electric Railway, said that he knew the character of the districts through which the line would pass, and believed that it would relieve the existing congestion. He believed the working expenses would be at 60 per cent., which estimate he based on the fares which it was proposed to charge. He had examined the gradients, and believed that the average speed would be 20 miles an hour, including stoppages. The gauge would be 4 ft. 8½ in. In the case of a goods traffic, it would most likely be found desirable to build electric locomotives, as the multiple unit principle would not be suitable for goods traffic. A steam locomotive could be used for goods trains. He considered that the live rail of electric railways should be standardised. An electrically-equipped train was under more complete control than a steam locomotive. He had found that an electric train travelling at the rate of 32 miles an hour could be stopped in 13½ seconds.

By Sir Ralph Littler: He based his estimate that the population would be carried 100 times over on his knowledge of the district.

At this point Mr. Pember asked if Witness could tell him what was the weight of the rails proposed to be used. Witness did not know, but it was announced that they would be 100-lb. rails.

Witness, cross-examined by Mr. Pember, said that the fire on the Liverpool Railway was due to the fusion of a motor.

The Chairman: Were you using the multiple unit system then?—Well, in a way; they were not iron-clad motors.

He understood that methods were to be adopted on the new line which would prevent such an accident.

On Thursday, April 30th, Mr. Steel was re-called and cross-examined. He said that he had worked out the following estimates of working expenses:—Power, including generating station, £110,469; station working (16 tube stations and 17 open stations), £119,800; cost of maintenance of line, £16,500 (including renewals); maintenance of 300 carriages, £9,000 per annum; general charges, £15,000; conductor rail, £20,000; cleaning of carriages, £5,000; cleaning of stations, £4,000; total, £289,769. He put the number of train miles at 7,056 per week day, and 1,411 on Sundays. Trains would run throughout the whole 24 hours at varying intervals. He put the working expenses per train-mile at 2s. 6¼d, and the receipts would have to be 4s. 7d. per train-mile.

Mr. T. C. Jenkin, the general manager of the City and South London, said that his company would not object to a clause being inserted in the Bill compelling it to agree to the construction of a subway between the stations of the two lines at Monument.

Counsel for the promoters said that it was hoped that similar arrangements would be made with the District Cc. Although that company objected to being compelled, it was in favour of a subway.

Cross-examined, Witness said that the Board of Trade had sanctioned several such cross-over roads as were proposed on this line. There were five on the City and South London.

The Chairman wished to re-call Sir Douglas Fox for the purpose of ascertaining the amount of the saving which would be made if the line north of Higham Hill were abandoned, as he was under the apprehension that that portion of the line would not be remunerative at the commencement.

Sir Douglas said that the amount would be £616,000. There would also be a saving of £19,000, owing to the fact that it was not now intended to take any property on the site of the Threadneedle Station. With regard to the extra cost of the larger-sized tube, witness said that a 13 ft. 6 in. tunnel would involve an additional expenditure of £220,000. In the case of a 13-ft. tunnel the extra cost would be £100,000. A quarter-hour service on the line north of Higham Hill, instead of a five-minute service, would mean a reduction of £220,000. In that case the cost of the Waltham branch would be £1,100,000 instead of £1,300,000.

In reply to Lord Robert Cecil: The cost of the line from Liverpool Street to the Monument would be about £470,000, less the amount which would be saved by not taking the property on the site of Threadneedle Street.

Cross-examined by Sir R. Littler: They proposed to have one generating station, as that was more economical than a number of small ones.

Mr. J. H. Lukach, a director of the British Westinghouse Electric Co. and of the Traction and Power Securities Co., stated that both of those companies were interested in that railway. The latter company had a capital of £2,000,000, of which one-half had been subscribed, and a further issue of £500,000 was contemplated. The American Westinghouse Co., in connection with which was Mr. George Westinghouse, was a separate concern from the British Westinghouse Co. The American company, upon witness's advice, had interested itself in this scheme, and to show the seriousness of their intentions they had cabled over £6,000 towards the pre-

liminary expenses. The British company had subscribed £5,000. Witness would not absolutely guarantee to find the whole of the capital; he could say that the companies with which he was connected and his associates would, no doubt, find the money, but he could not bind them in a matter of this kind.

Mr. Wack proceeded to give similar evidence, but the Chairman remarked that witness did not appear to have any different evidence, and said that the Committee had decided to confer, and ordered the room to be cleared.

After conferring for a few minutes, the Chairman announced that the Committee were unanimously of opinion that the preamble had not been proved. He remarked that the Committee thought that, in future, it would be desirable if the financial aspects of a Bill were presented before the engineering evidence, as it would possibly lead to a saving of time.

Lord Robert Cecil, on behalf of the Colonial Bank, and counsel for the two other banks opposing, applied for costs to be allowed, but the Chairman said that the Committee could not award costs in either case.

Stroud District and Cheltenham Tramways Bill.

A Select Committee of the House of Commons, presided over by Sir Lewis M'Iver, on Wednesday last week commenced the consideration of the above Bill. The promoters were represented by Mr. Balfour Browne, K.C., the Hon. J. D. Fitzgerald, K.C., and Mr. C. C. Hutchinson. Mr. Moon, K.C., Mr. H. Lloyd and Mr. F. W. Pember represented the Great Western Railway, and Mr. Baggallay, K.C., and Mr. Oxley the Midland Railway Co., who were opposing.

Mr. Balfour Browne, in opening the case for the promoters, said it was proposed to incorporate a company to acquire and maintain tramways in the County of Gloucester. There was one novel feature in the Bill, for they not only proposed to make tramways, but, before tramways were necessary, in some of the Cotswold valleys they proposed to run motor-cars by means of the overhead trolley system without running them on rails. That system had been adopted in various places abroad, and had proved very successful. The only thing against it was that if they were going to work motors along the road on the overhead system they would have to have two wires. In the ordinary course of tramway traction the current was returned along the rails, but in this case it would be returned along the second wire, and this in a sense he believed would contribute to safety. Of course there would be more friction in running along roads than along rails, so that it would be necessary to have a greater amount of power; but, on the other hand, the gain was very great indeed. An ordinary tramway would cost about £7,000 to lay per mile, while the proposed overhead traction would cost £1,000 per mile. This cost was comparatively a small matter, and for the development of these country districts it was very important that places which could not bear the large expense of tramways should be given accommodation at once. Stroud would be the centre of the system, the points to which the service was extended being Chalford, Nailsworth, Stonehouse and Painswick, and thence to Cheltenham. The opposition of the railway companies was only upon competition, but it was evident that the Midland and Great Western Cos. could not compete with this system of pick-up traffic. All the local authorities were in favour of the Bill. The estimated cost of the entire scheme was £250,000, but this included the construction of some tramways not at present to be proceeded with. There was not the slightest difficulty in raising the capital required for the undertaking, for not only were the financiers prepared to find the money, but the local public were prepared to subscribe.

Mr. E. T. Gardom, clerk to the Gloucester County Council, stated that the Council were quite willing that the roads should be utilised for the purposes proposed. In certain places the promoters had agreed to improve the roads.

Mr. Kimmins, vice-chairman of the Stroud Rural District Council, also supported, and said it was intended to carry agricultural produce on the tramways. He preferred motors to tramways on the roads.

A large number of local witnesses were called in support of the Bill.

Mr. A. A. Campbell Swinton, the engineer for the scheme, was examined, and described the routes of the different sections of the tramways. He regarded the route as an excellent one, both from an industrial and agricultural point of view. The traffic would be of a kind which would prove remunerative. Omnibus traffic offered some basis of calculation, and it was the universal experience that the substitution of electric traction brought an enormous increase in the number of passengers. Overhead construction, where it was first intended to use it for motor omnibuses, could afterwards be utilised without additional capital expenditure. He did not agree that there would be an interference with the Midland Railway Co., but on the contrary, the scheme was likely to bring increased passenger traffic. It was proposed to work the Northern line by means of trolley omnibuses from Stroud to Cheltenham in the first instance, but it was hoped before long they might convert the portion between Stroud and Painswick into ordinary tramway construction. He estimated the total outlay at £123,883. The amount of capital was £200,000, with one-third borrowing power, making £266,000, and leaving £142,000 for equipment. It would not be necessary for the promoters to build a power station, for the Gloucester Power Co., which was incorporated last year, proposed to build a power station at Dudbridge, and the promoters expected to make an advantageous arrangement with them to acquire all the requisite power. The Gloucestershire Power Co. would supply the motive power to mills in the locality, and they could supply the power cheaper than the promoters could. The necessary capital had already been arranged for. The poles were to carry two trolley wires; under ordinary tramway schemes with a single wire the electricity returned through the rail. The initial expense for overhead equipment would not have to be increased, and they would save with regard to permanent way, which was an expenditure which even populous districts could ill afford to bear. He had made himself practically acquainted with places where the proposed scheme was carried out, and the principle was the same as that in operation between Fontainebleau and Samois. He had satisfied himself that the proposed methods were sound and practicable, and the wonder to him was that they had not been used before.

In cross-examination by Mr. Moon, Witness said he did not regard the opposition proposal of the Great Western Railway Co. to run motor-cars as at all practicable. The scheme did not originate with the Gloucestershire Power Co., of which his partner was a member. Only three of the promoters of the scheme were connected with the Power Co. As to whether it would be a nice thing for the Power Co. to have a tramway company to supply, that, of course, depended upon the price at which they would supply.

Answering Mr. Fitzgerald, Witness said the Gloucester Power Co. would be able to supply cheaper than anybody else. A 15-minute service was contemplated for the Stonehouse route, and for the Nailsworth section, the service would be a little under half an hour. For the Painswick and Cheltenham route, a 2 hours' service was suggested, but that would be a matter of experiment. There would probably be special cars for goods, but light parcels could be taken on the ordinary cars.

Replying to Mr. Baggallay, Witness said there was no case in the country in which a company had statutory powers to run motor-cars such as were proposed by the Bill, but there were cases such as at Scarborough, where statutory powers to run motors in connection with tramways existed. Their proposal was subject to certain restrictions about consents to run the motor-cars with trolleys over any road within seven miles of any route authorised. The motor omnibuses he saw in France, were about 3 tons in weight, and he thought they were rather too heavy. Something lighter would be required in that scheme. The speed of the trolley omnibuses would be seven miles an hour.

Mr. H. Samuel (a member of the Committee): Do you contemplate allowing the public to use the wires for trolley electric locomotion?—That is not contemplated now, but there is no reason why such a system should not be adopted eventually.

I believe such a plan is contemplated on the Continent; I can quite see that in the future the whole of England may be covered with a network of wires for public use?—Quite so.

Continuing, Witness said he did not think pneumatic tires would be practicable, but solid tires might be used.

By the Chairman: The scheme would be over capitalised but for the contemplated tramways. The overhead wires for motor omnibuses would give no direct course, and there would be sufficient flexibility to enable the driver to so guide his car as not to get in the way of other vehicles. There would be no monopoly of the road under the system.

Other engineering evidence was called, and the promoters' case was closed.

The Great Western Railway Co.'s opposition was then heard.

Sir J. Wilkinson, the general manager of that line, said he regarded the scheme as competitive with his railway. The Great Western had experimented with a petrol engine, but it had not been a success. They had decided to try a service of steam-worked motor-cars between Chalford and Stonehouse, and he approached the Board of Trade in that matter.

Mr. Moon, K.C., addressed the Committee on behalf of the Great Western Co. He contended that no case had been made out for the scheme so far as Cheltenham and Stroud were concerned. The Chalford and Stonehouse lines would compete with his clients' railway.

Mr. Baggallay, K.C., for the Midland Railway, said that the proposed lines from Stroud to Nailsworth would compete unfairly with the Midland Railway's line. He asked the Committee to reject the proposed lines from Stonehouse to Stroud and from Dudbridge to Nailsworth.

The Committee having conferred in private for nearly half an hour, the Chairman, on the re-admission of the public to the room, asked whether the County Council would agree to certain alterations to which the promoters had agreed.

Mr. Balfour Browne said that he hoped so.

The Chairman then said that, in the event of the Committee finding the preamble proved, they would be unwilling to grant anything in the nature of a monopoly on a new scheme. Would the promoters be likely to agree to a provision giving facilities to private persons to run cars for a toll or rate if the cars were so made as to suit the trolleys?

Mr. Balfour Browne saw great difficulties, not only engineering difficulties, but practical ones as well.

The Chairman: It would be extremely improbable that it could be done, but then the Committee had to look a long way ahead.

Mr. Balfour Browne said he would recommend the promoters to accept a clause allowing persons to use the trolley wires.

Ultimately the Committee found the preamble proved, with the exception of the line through Painswick to Cheltenham, which would have to be dropped.

Seaforth and Sefton Junction Railway Bill.

On Wednesday, Thursday and Friday last week, a Select Committee of the House of Commons, presided over by Sir W. H. Holland, considered the Seaforth and Sefton Junction Railway Bill, which seeks to authorise the construction of a new railway,

4½ miles long, to connect the Liverpool Overhead Electric Railway at Seaforth, with the Cheshire Lines Extension at Sefton. Mr. Moon, K.C., Mr. H. Lloyd and Mr. Vesey-Knox were for the promoters, and there was opposition by the Liverpool Corporation (represented by Mr. Fitzgerald); the Lancashire and Yorkshire Railway (Sir R. Littler, K.C., Mr. Balfour Browne, K.C., and Mr. Acworth); the Earl of Sefton (Mr. Fitzgerald and Mr. Squary), the Sefton Rural District Council and the Mersey Docks and Harbour Board.

Mr. Moon, K.C, in opening the case for the promoters, said the railway would provide for an important and populous district, and would give another through route from Liverpool to Southport. It would also enable minerals and goods to be brought to the Northern End of the Liverpool Docks. The capital of the line was £270,000. The line would be worked by the Overhead Railway, and would be an overhead service. It would be worked by electricity for the passenger service, and chiefly by steam for the carriage of goods. The passenger service would be a prolongation of the Liverpool Overhead Service, and the goods traffic would be worked by steam engines belonging to the Southport Extensions Railway. He contended that the line would in no way interfere with the traffic of the Yorkshire and Lancashire Railway, and a clause for the protection of the water mains of the Liverpool Corporation had been prepared. The other objections, he submitted, could be met by clauses.

A large number of witnesses were called in favour of the scheme.

Mr. Balfour Browne, K.C., said he had a suspicion that the railway could not be made at all without the consent of the Mersey Dock Board, and that they would not allow the railway to have the land.

Mr. S. Fay, general manager of the Great Central Co., supported the scheme, and said the Cheshire Lines Committee would have no objection to the electrification of the whole system through to Southport in conjunction with the proposed junction line. The latter, together with the line proposed in the Cheshire Lines Bill, would enable a circular service of trains to be run right round Liverpool. In view of the fact that the earnings per mile of the Liverpool Overhead Railway were something extraordinary, and that the proposed line would be in conjunction with it, and would also have a very heavy coal traffic, he thought there would be no difficulty in raising the money required.

Sir Wm. Forwood, chairman of the Overhead Railway, welcomed the scheme, which would bring more traffic to his line. The Lancashire and Yorkshire Railway themselves proposed to use the Overhead Railway for coal traffic. At present the Overhead Railway did not carry mineral traffic, but by the construction of special wagons, or by the expenditure of £80,000 on structural alterations, the line could be adapted for mineral traffic. The Overhead Railway were to work the proposed line for passenger traffic, and 6 per cent. of the gross receipts had been suggested as the basis of negotiations.

Mr. S. B. Cottrell, M.Inst.C.E., the general manager of the Overhead Railway, was then called. The cost of the line he estimated at £232,561. There was an unopposed Bill before Parliament by which there would be made a connection between the Overhead Railway and the Cheshire lines at St. Michaels. That junction, together with the line now proposed, would complete a belt round Liverpool 27 miles in length. If the whole line were electrified, the entire journey could be made in 91 minutes, including stopping at each station. There would also be a connection with the Cheshire side of the Mersey, as a junction was already authorised at St. James's Station, between the Cheshire Lines and the Mersey Tunnel Railway.

Mr. Fowler, M.Inst.C.E., of Liverpool, said that he had laid out the proposed line in conjunction with Mr. Cottrell, and could see no difficulty in crossing the Lancashire and Yorkshire line.

Sir Douglas Fox, the chief engineer to the Liverpool Overhead Railway, was also called in support. He thought that it would be quite practicable for the Overhead Railway to carry minerals along its line. Certain strengthening in parts would have to be carried out, but he believed that it might be covered by the sum of £80,000. In his opinion the line should have been constructed for a mineral traffic in the first instance.

Evidence as to land values concluded the case for the promoters.

The opposition was then heard.

Mr. Balfour Browne, K.C., for the Liverpool Corporation, said that one of their objections was that the proposed line would turn the Overhead Railway into a line for through traffic. Another thing to which they objected was the use of steam along the docks.

Mr. Cottrell said that they had power to use steam under the existing Acts.

Mr. Acworth, for the Lancashire and Yorkshire Railway Co., said that it was unprecedented for Parliament to sanction a scheme which would depend for its execution upon a subordinate body like the Dock Board.

Mr. Aspinall, general manager of the Lancashire and Yorkshire Railway Co., called in support of the opposition, contended that the proposed railway would be a competitor with his line, upon which over a million had been spent. At the present time they were well advanced with the conversion of their system to electric traction, and they objected to competition being thrust upon them. The new route proposed to cross their lines, and it would greatly interfere with the operation of a large crane which they proposed to use upon their rails for dealing with the timber trade.

On resuming the consideration of this Bill on Monday, Sir Ralph Littler, K.C., addressed the Committee on behalf of the Lancashire and Yorkshire Railway Co., and asked them not to sanction the Bill. He said that the new line was to be in competition with the best services in England, upon which £1,100,000 had been spent, and which would shortly be worked by electricity.

Mr. Moon, in reply, urged that the opposition of the Lancashire and Yorkshire Railway was actuated purely by personal motives, and should not weigh with the Committee.

The Committee declared the preamble of the Bill proved, subject to the passenger traffic being worked by electricity.

South-Eastern and Chatham and Dover Railways Bill.—Lord Lauderdale's Select Committee of the House of Lords had under their consideration on Friday and Monday, the Bill of the South-Eastern and London, Chatham and Dover Railways Co. Sir Ralph Littler, K.C., who, with Mr. Boyle, K.C., appeared for the promoters, said that the principal object of the Bill was that contained in Clause 4, which empowered the managing committee of the company to work the traffic of the railways by electrical power, and for that purpose to lay down along such railways, and maintain and use electric cables, mains, lines and apparatus for the transmitting of electric energy. The only opponent to that part of the Bill was the Corporation of London, but terms had been arranged with that body, and consequently the opposition was withdrawn. The other opposition was to the portion of the Bill which had reference to an agreement which had been entered into between the South-Eastern Railway Co. and the Medway and Thames Canal Co. with regard to the Gravesend and Higham Canal, which was the property of the company. Last year it would be remembered a Bill was passed for the construction of a canal joining up the Thames and the Medway, to be operated electrically. The promoters of the Bill had formed themselves into a company, and it was now proposed to transfer to them all the rights of the railway company in the canal on a lease of 999 years. After hearing evidence, the Committee found the preamble of the Bill proved subject to the insertion of a clause protecting the towing path of the canal. Mr. Page, K.C., who appeared for the Medway and Thames Canal Co., pointed out the importance of his clients' interests, and said the retention of the towing path might be fatal to the widening and deepening of the canal, and to its being worked by electrical power. Sir R. Littler argued against anything being put in the clause which would give the Canal Co. powers they did not have before. The Committee adjusted the clauses to give the Canal Co. the same facilities as those already possessed by the existing canal.

Metropolitan District Railway (Various Powers) Bill.—On Wednesday, April 29th, the Court of Referees considered the application of the London County Council for a *locus* to appear in opposition before the Select Committee who considered the above Bill. The petition was supported by Mr. E. Pollock, K.C.

Mr. Freeman, K.C., on behalf of the Metropolitan Co., objected to the general *locus* sought by the Council, and said that if such a *locus* was to be granted in regard to Omnibus Bills, railway companies would not bring such Bills in, but would frame separate measures.

The Court decided to allow the County Council a general *locus* as landowners, but they wished it to be understood that they did not intend in giving that decision to influence the Committee before whom the Bill would come in their judgment as to what might or might not be considered material in dealing with the interests of the petitioners as affected by the Bill.

Leigh Corporation Bill.—On Wednesday, April 29th, the Select Committee concluded the consideration of this Bill, and declared the preamble proved. Owing to the elimination of the tramway line to West Leigh the estimates were reduced from £62,500 to £50,000 for the construction of the lines, and from £9,450 to £7,210 for electrical equipment.

North-Western Electricity and Power Gas Bill.—On Friday the promoters of this Bill appeared before the Examiner in the House of Lords for leave to insert an additional provision empowering the company to take certain lands of 5½ acres in the urban district of Stone, in the county of Stafford, for a power station. Standing Orders were found not to have been complied with, and the Bill will accordingly go before the Standing Orders Committee.

Baker Street and Waterloo Railway (Extension of Time).—In the case of this Bill the Standing Orders Committee of the House of Commons has decided that Standing Orders shall be dispensed with and the Bill allowed to proceed.

South Shields, Sunderland and District Tramways.—The Court of Referees have refused a *locus* to the Sunderland and South Shields Water Co. and the South Shields Gas Co. to appear in opposition to this Bill.

Antrim, Down, Armagh and Belfast Electric Power Bill.—On Friday it was notified by the Chairman of Committees in the House of Lords that the promoters of the above Bill did not intend to proceed with the measure. The Bill was an important one, as it was proposed to incorporate a company with a capital of £1,200,000 and borrowing powers of £400,000, and the area scheduled was the whole of the counties of Down, Antrim, Armagh, and the City and Borough of Belfast.

Coventry Electric Tramways.—The Deputy Chairman, reporting from the Committee which considered this Bill to the House of Commons, states that the Bill authorises the Coventry Corporation to acquire at specified dates the undertaking of the promoters, and to work the same, and that some of the tramways to be acquired and worked are situate beyond the limits of the City of Coventry. The tramways situate outside the City are in connection with the tramways within the City; and having regard to the special local circumstances, the Committee are of opinion that the powers to the Corporation to acquire and work the undertaking as a whole, which in respect of such acquisition are a re-enactment of similar powers contained in the Coventry Electric Tramways Act, 1897, ought to be allowed, and that consequently it is not expedient to insert the clause referred to in Standing Order 170A for the protection of the

parish councils of the districts in which the tramways outside the City of Coventry are situate.

Carmarthenshire Electric Power Bill.—The above Bill was down for consideration by the Select Committee of the House of Lords, presided over by Lord Glenesk on Tuesday. It was stated that all opposition had been withdrawn, and the Bill was accordingly removed from the group.

Shropshire, Worcestershire and East Denbighshire Electric Power Bill.—On Tuesday it was reported by the Chairman of Committees of the House of Lords that the opposition to this Bill had been withdrawn, and it was accordingly removed from the group before the Select Committee.

Bournemouth Corporation Tramways.—The Bill of the Bournemouth Corporation, which empowers the Corporation to maintain and use tramways authorised by the Bournemouth Corporation Tramway Order, 1900, and to acquire the undertaking of the Poole and District Electric Traction Co., Ltd., was down for consideration before Lord Newton's Committee of the House of Lords on Monday. There were no appearances, and it was stated that opposition had been withdrawn.

Romford and District Tramways.—This Bill was before the Examiner on Friday on a petition for an additional provision. Standing Orders were found not to have been complied with, and the Bill will have to go before the Standing Orders Committee.

Hove, Worthing and District Tramways.—A petition against this Bill has been presented in the House of Lords by the New Shoreham U.D.C. The British Electric Traction Co., who are the promoters, are seeking to insert an additional provision in the Bill, and the matter will have to come before the Examiner.

LEGAL.

Municipal Trading in Electrical Apparatus.

In the Chancery Division of the High Court of Justice on April 30th and May 1st, Mr. Justice Joyce, in the case of the Attorney-General *v.* the Mayor, Alderman and Burgesses of the Borough of Barnstaple, had before him an action at the relation of Mr. Cantler for a declaration that the Corporation of Barnstaple was not entitled to supply or deal in electric lamps, wires or other things, or to fix and wire houses within the borough, and for an injunction to restrain the Corporation from doing anything which was not expressly provided for in the Corporation's Electric Lighting Order of 1900. Mr. Younger, K.C., and Mr. Cann appeared for the plaintiff; Mr. Hughes, K.C., and Mr. McSwinney for the defendants.

Mr. Cann said the salient features of the Electric Lighting Acts of 1882 to 1888 were that they enabled an authority which had obtained the benefit of them to do certain things. The dominant words of the Act were "the supply of electricity."

Mr. Justice Joyce: We must see what is the power referred to in Sec. 2 of the Act of 1882. It goes without saying that the Corporation cannot do what they are doing unless they are specially authorised by Parliament to do it. They need not be necessarily authorised in so many words, but they must be authorised.

Mr. Hughes, who, with Mr. McSwinney, appeared for the defendants: This is a municipal corporation constituted by charter.

Mr. Justice Joyce: Do you say they do not want a provisional order at all?

Mr. Hughes: Except so far as they want compulsory powers, or except where they propose to pay out of the rates, which they do not propose to do.

Mr. Cann: Then I must refer to the Municipal Corporations Act. The statement of the claims sets out that the defendants are the local authority of the borough of Barnstaple within the Electric Lighting Acts of 1882 and 1888. The provisional order was granted in 1900, and it came into force on June 25th, 1900, the day when the confirming Act received the Royal Assent. The defendants have laid distributing mains for the purpose of generating and distributing electricity, and, of course, that the plaintiffs did not quarrel with. Then comes the point where we submit the defendants have gone beyond their powers, for they have issued circulars with a view to this private installation. The defence is that under the provisional order referred to in the statement of claim, they have power to supply electricity to the borough.

Mr. Justice Joyce: That means not to the borough, but to people within the borough?

Mr. Cann: Yes; that means electricity as defined by the Act. As incident to the exercise of such power, the defendants say that under the general law and under the general Acts and provisional order, they have power to supply, let on hire and set up within the borough, wires and other fittings. Defendants had sold, let on hire, supplied, fixed and set up fittings and apparatus in the exercise of the power. Defendants did not admit that they threatened and intended to continue to do the acts of which plaintiffs complained.

Mr. Justice Joyce: And they intend to do it?—There is no doubt about it.

Mr. Hughes: We do not intend to do it in the future. We have done all we have ever wanted to do.

Mr. Justice Joyce: Then what is the use of this action?

Mr. Hughes: I do not know.

Mr. Justice Joyce: Have you really dropped it?

Mr. Hughes: For the purposes of starting the undertaking we have installed and wired houses up to a certain extent. We do not want to go on in the future.

Mr. Younger: Yet they have undertaken to maintain the wiring for a period of three years.

Mr. Cann: And maintain the wiring at the expense of the rates.

Mr. Hughes: We do not want to do any further work of that kind.

Mr. Justice Joyce: You say that and mean it, of course. Then this action resolves itself into an action to prevent the defendants from maintaining the wires they have installed.

Mr. Younger: Of course this abandonment, if it has taken place, was only within the last few days.

Mr. Justice Joyce: Is it worth while to object to their doing this?

Mr. Cann: I do not know what undertaking my learned friend is prepared to give. He may say at the present moment that he does not intend to do anything more, but——

Mr. Younger: I may be relying on certain information in the public Press. It may be that within the last week or two that the Corporation have determined not to do this, but they desire that it should be judicially determined.

Mr. Justice Joyce: I do not care for what they desire.

Mr. Younger: It is municipal trading or non-municipal trading.

Mr. Justice Joyce: I am not going to decide anything but practical questions.

Mr. Hughes desired to state what was the exact position of the undertaking. The money borrowed for the purpose was £21,600, and that amount was sanctioned by the Local Government Board. The Corporation found that the people in Barnstaple, not understanding much about electricity, were a little shy of taking the supply unless the Corporation wired the houses. The Corporation did that out of the borrowed money, and not out of the rates.

Mr. Justice Joyce: That does not cure anything. The rates are liable for the borrowed money.

Mr. Hughes: The borrowed money is secured on the rates. We have wired houses out of the borrowed money.

Mr. Justice Joyce: How do you know you did it out of the borrowed money?

Mr. Hughes: The accounts are all kept separate. We have not applied rates for it in any way, and we do not propose to do so. In some cases people have paid cash down for the work done, and it has come back into our pockets.

Mr. Justice Joyce: In how many cases—20, 30, or 100?

Mr. Hughes: I am not sure as to the total number, but the number who have not paid cash is 14; others are paying under what is known as the "free wiring system."

Mr. Justice Joyce: That is hire and purchase.

Mr. Hughes: It is spread over a number of years. It amounts to a small sum, and so far from the ratepayers having suffered there is likely to be a small profit.

Mr. Justice Joyce: It is quite clear that you have been advised not to go on.

Mr. Hughes: That is not so.

Mr. Younger: I would not ask that the Corporation should be restrained by injunction from fulfilling the contracts which they have made for wiring houses. But if my learned friend's clients will submit to a declaration that they are not entitled to do these things, I shall ask for no further relief, except that the plaintiffs be paid the costs of the declaration and of the action.

Mr. Justice Joyce: We are on this point now. The defence says they did it as incident to their powers, but Mr. Hughes has intimated that he is going to argue that, quite apart from the accounts—outside the accounts—being a municipal Corporation, the defendants are entitled to do what they have done. I confess it startles me a little.

Mr. Younger: It is not pleaded.

Mr. Justice Joyce: It does not matter about pleadings on this point. How are you going to keep this off the rates, Mr. Hughes?

Mr. Hughes: We have already got back almost all, and we shall get back rather more than we have expended.

Mr. Justice Joyce: Suppose you do not? There may be deaths and bankruptcies.

Mr. Hughes: In point of fact, there is no risk of there being any loss, because, as I have said, we have nearly got back all the money.

Mr. Justice Joyce: There are 14 cases outstanding yet.

Mr. Hughes: They amount to a trifling sum.

Mr. Justice Joyce: I do not understand that you kept all your money separate.

Mr. Hughes: We have to. We have kept separate banking accounts; the accounts are kept quite separate, and we have to be careful about it. Our accounts are all audited.

Mr. Justice Joyce: Are you pledged to keep separate accounts; it may be merely paper.

Mr. Hughes: I am not sure that we are under any obligation to keep separate banking accounts.

Mr. Justice Joyce: You know that loans are authorised for a specific purpose, and surely there is some means under which they have to be so applied. Loans are not going to be raised for sewage works and applied in electric lighting.

Mr. Hughes: The loan was raised for electric lighting purposes.

Mr. Justice Joyce: That is a compendious designation.

Mr. Hughes: And we are not applying it to anything but electric lighting purposes.

Mr. Justice Joyce: Then you must be under an obligation to keep a separate banking account.

Mr. Hughes: It may be so. I am not sure that we would not have to keep it in a separate account at the bank, but, at any rate, we have done so.

Mr. Justice Joyce: Mr. Younger very fairly says he does not care about the 14. Of course he can always bring a new action or apply again.

Mr. Hughes: The truth is, there was no tradesman in the town competent to do the work. There is now, and there is no difficulty about it, and people in Barnstaple know the advantages of electric lighting.

Mr. Justice JOYCE: Then the only question is as to the costs of the action.

Mr. YOUNGER: My friend is not now entitled to put forward a defence he has not pleaded.

Mr. Justice JOYCE: Do you say that at all events on the defence he sets up he ought to pay the costs?

Mr. YOUNGER: Certainly.

Mr. Justice JOYCE asked if the defendants desired to amend?

Mr. HUGHES: If it is necessary I shall ask for that leave.

Mr. Justice JOYCE: Until you ask to amend we will keep to the pleadings.

Mr. HUGHES: I ask leave to amend.

Mr. YOUNGER: Then I apply that that leave be only given on terms.

Mr. Justice JOYCE: The defendants must pay the costs up to the amendment unless they satisfy me on the pleadings.

Mr. HUGHES: Then it is a question of general law. The learned counsel said that by paragraph 2 of the defence the defendants pleaded that under the general law and under the Acts and provisional order they had power to do what the plaintiff complained of. This was not the case of the anxious ratepayer, the only real opposition was from the gas company. That was of course immaterial if the Attorney-General was right, but as a matter of fact it was well known that the ratepayers were all in favour of this being done. With regard to the law, he should submit that this Corporation was not in the position of the London County Council, for example, who only had certain specific powers to do those things for which it was created, nor was it in the same position as the Great Eastern Railway Co., who were restrained from manufacturing engines for sale because they were a company incorporated by Act of Parliament with certain limited powers. The defendants were a Municipal Corporation, having every power that every individual had subject only to this:—Because they wanted to raise money, and they could only raise money subject to the sanction of the Local Government Board, and because they wanted certain compulsory powers. Otherwise they had power to carry out this work without the necessity of obtaining the sanction of anyone.

Mr. Justice JOYCE said that that argument related to the other question, which he had decided could only be raised by amendment.

Mr. HUGHES submitted not, and he should contend that that question was raised by the defence as it now stood. The defence raised a question under the general law.

Mr. Justice JOYCE: Yes, but the general law merely as it was applicable or incident to the powers mentioned by the special Acts of Parliament relating to this matter.

Mr. HUGHES: If your Lordship reads the defence in that way—

Mr. Justice JOYCE: And I do.

Mr. HUGHES: Then I shall have to argue the case upon that limited footing or take leave to amend. Perhaps your Lordship will let me see if my clients care to have it argued in that way.

Mr. Justice JOYCE: Certainly.

Mr. HUGHES, having consulted his clients, submitted that as the statement of claim referred to the defendants being a municipal corporation, it was open to the defence to show that they were a municipal corporation, and as such had the right under the general law to do what they were doing.

Mr. Justice JOYCE asked counsel for the plaintiff if they were willing that he should give leave to amend, making the costs incurred up to the present costs in the action as amended?

Mr. YOUNGER said that he did ask his Lordship to deal with the costs now, and make it a condition of the defendants amending that they should pay the costs of the action up to the present time. He could not consent to any amendment except upon those terms.

Mr. HUGHES suggested that the defendants should have leave to amend unconditionally, and that his Lordship should deal with the costs after the action on amendment had been tried.

Mr. Justice JOYCE asked when would the defendants be prepared to amend.

Mr. HUGHES said now at once.

Mr. Justice JOYCE suggested that they had better consider the subject before they did.

Mr. HUGHES said that he did it quite deliberately. His Lordship could deal with any further costs incurred.

Mr. Justice JOYCE asked whether he was willing to take the amendment of the terms of abiding by any order the Court might make as to costs.

Mr. HUGHES said he was not in a position to consent. The members of the Corporation felt rather strongly about the matter as the action was not a ratepayers' action at all. He did not think that his learned friends on the other side would deny that.

Mr. YOUNGER said that indeed he did deny it.

Mr. Justice JOYCE said that he should suggest that the action should stand over until after next Monday week. Could the amendment be made by next Wednesday? The matter could then stand over until after Monday fortnight.

Mr. HUGHES: Will your Lordship just give me five minutes?

Mr. Justice JOYCE: Certainly. I was going to suggest that you might amend, if at all, next week, and then the action need not come on again until the week after.

Mr. YOUNGER said that if the amendment were made he should ask for a longer time than that, as the amendment would give rise to a totally different state of facts.

Mr. Justice JOYCE pointed out that he could always apply for the case to stand over.

Mr. HUGHES having consulted with his clients and afterwards with Mr. Younger, stated that the parties having agreed that subject to the consent of the Attorney-General, which he had no doubt they could obtain, the defendants stating that they did not intend to do anything further with reference to the Acts specified, except so far as was necessary for the purpose of carrying out existing obligations, there should be no injunction and no declaration, and he had, subject to the consent of the Attorney-General, arranged with counsel for the plaintiff as to the expenses of the action.

Mr. YOUNGER said that was so.

Mr. HUGHES said that the defendants were going to wire buildings of their own. It was, of course, understood that the statement did not extend to those buildings. He wished that to be clearly understood.

Mr. YOUNGER said there would be no misunderstanding about that.

Mr. Justice JOYCE accordingly made an order as arranged.

ISAACSON v. NEW GRAND, LTD.

THIS action came before Deputy-Judge Lush Wilson, K.C., and a jury in the Westminster County Court on Friday, and involved a question of vital interest to electricians—that of whether an electrical engineer is a workman within the meaning of the Employers' Liability Act. The plaintiffs were Mr. and Mrs. Isaacson, and they were seeking to recover damages from the New Grand (Clapham Junction), Ltd., under the Act mentioned, for the loss of their son, who met with his death while in the company's service as an electrical engineer on July 31st, 1901. The case has been before the Courts on 15 occasions, owing to the legal intricacies, and the various proceedings have been reported from time to time in the ELECTRICAL REVIEW. It first came before Deputy-Judge Horton Smith, K.C., in this Court, and he non-suited the plaintiffs on the ground that their son was not a workman within the meaning of the Act, declining to allow a witness to be re-called to give evidence on that point. The Divisional Court held that the witness should have been recalled, and sent the case back for a new trial. It then came before Judge Woodfall, who non-suited plaintiffs on the ground that the company had not been proved negligent. Not on either occasion did the case go to the jury. The Divisional Court sent the case back for a jury to decide as to the negligence. There had also been several applications in connection with the case. Mr. J. Watson Moyses was counsel for the plaintiffs, and Mr. Minton Senhouse for the defendants.

Mr. MOYSES said the music hall of the defendants had been open for about four months, and young Isaacson had been there all the time. The company had at that time several halls, and had an electrical engineer, Mr. Rayner, to superintend the installations at all their buildings. At Clapham Junction Isaacson was in charge. He was 23 years of age and took a great interest in his calling, having secured about 30 certificates for proficiency in the various branches of electrical work. On the day of his death, Mr. Rayner was present on the occasion of blowing down the boiler. When that was done a quantity of boiling water had to be disposed of, and as the local authorities, for various reasons, would not allow it to go straight into the sewers, it was necessary to cool it first, and for that purpose a sump was used, but it was not of sufficient capacity to take all the water, and therefore a cover—which was used instead of a grating—had to be lifted off when the blowing down was going on, or it would be lifted off by the steam or the water. Isaacson was making sure that a tube, which had been obstructed, was clear, by pushing a length of tubing through it, and was pulling the tubing out, walking backward, when he fell through the opening caused by the removal of the cover, into the sump, and was scalded to death. At the time there had been proceedings with reference to the vibration caused by the electrical machinery, and a trench had been made round the boiler house, the clay from the trench being piled up in the way, and, altogether, this place was a death-trap, owing to the dangerous position of the sump, its incapacity and the obstruction caused by the soil. It was discovered accidentally in one of the trials that the sump was not to be in its present position according to a plan that was produced by the other side. For some reason or other the engineers or architects had altered its position from one of safety to one of danger—to a position right in the way of one of the doors, that one being the one open on the day in question, the other being blocked up by the soil from the trench. The Coroner's jury found the company was negligent. In addition to the two guineas a week and overtime Isaacson had from the company, he was in partnership with a Mr. Hill. He lived at home and was the mainstay of his aged parents. When the company was written to, a reply was sent referring plaintiffs to an insurance company, and that company had been fighting them ever since. Under the Act the most that could be claimed was three years' wages, and he submitted the full amount should be given—£327 12s.

The parents gave evidence as to pecuniary loss, and Mrs. ISAACSON said in cross-examination, that her son, in addition to the scholarships he won, was writing a book on a technical subject.

Mr. F. W. RAYNER, A.I.E.E., gave evidence in support of the opening statement, and stated he was now employed by the Camberwell Borough Council. Isaacson was a working mechanical engineer and used tools. He had to alter the wiring weekly for stage effects.

Mr. J. OWNER, one of H.M. Inspectors of Factories, who represented the Home Office at the inquest, said, in his opinion, the sump was unsafe.

Mr. C. COOPER, consulting engineer, with over 40 years' experience, deposed that the sump was in a most dangerous position, and the capacity was too small.

Mr. HILL, deceased's partner, said he had seen him doing manual work while in defendants' employ.

Mr. SENHOUSE submitted that deceased was not a workman within the meaning of the Act.

The DEPUTY JUDGE: That it was not an essential part of his duties to do manual work?

Mr. SENHOUSE said that was his position. Electrical engineering

work was done by skilled engineers. The "plan" referred to by Mr. Moyses was merely a sketch produced by one of the witnesses. The sump was made under the direction of consulting engineers, and the whole was passed by the authorities.

Evidence was then given that Isaacson's chief duty was to watch the switchboard, and if he did anything else it was voluntarily. His exact duties were to supervise the running of the electrical plant, and, when necessary, to "lend a hand." Hooper, the boiler attendant, had already satisfied himself that the tube was clear, and Isaacson knew the cover was off the sump. It was a pure accident.

Mr. Senhouse pressed his point that deceased was not a workman. He was highly skilled, and was actually writing a book.

Mr. Rayner, re-called by the Judge, said it was part of his duties to see that the ways, works, and machinery or plant were in proper order. He did not call the attention of his employers to any defect.

The jury found deceased was a workman within the meaning of the Act; the employment, having regard to the premises and mechanical structure, involved risks of a dangerous character; all reasonable precaution was not taken to protect him; he did not contribute to the accident, materially; the ways, works, and machinery and plant were defective; Rayner was entrusted with the superintendence, and was guilty of negligence in not discovering and reporting the defect; deceased's death was due to negligence; deceased knew of the danger and appreciated the risk. They found for the plaintiffs for £100.

Mr. Senhouse, on the finding that he knew of the danger and appreciated the risk, opposed judgment being entered for the plaintiffs, as there was nothing to compel him to take a voluntary risk.

Judgment was deferred.

Baleau v. The National Telephone Co.

In the Chancery Division, on Friday, before Mr. Justice Kekewich, Mr. Courtney Terrell mentioned the case of Baleau *v.* The National Telephone Co., on a motion by the plaintiff, who resides at 15, Alexandra Villas, Brighton, for a mandatory injunction calling upon the defendants to remove certain telephone wires which passed over her garden. Learned counsel said that the defendants had consented to a perpetual injunction in the terms of the notice of motion, to be suspended for a month so far as the open wires were concerned, and for two months with regard to a cable which crossed the property, the defendants consenting to pay the plaintiff's solicitor's and client's costs.

Manchester Carriage and Tramways Co. *v.* the Manchester Corporation.

In the Court of Appeal on Monday, Lords Justices Vaughan-Williams, Stirling and Mathew again had before them the appeal by the Manchester Corporation and the District Councils associated with them, against the decision of Mr. Justice Bigham. The point to be determined was raised by a special case stated by Sir Frederick Bramwell, the arbitrator appointed for the purpose of settling the sum payable by the authorities to the Manchester Carriage and Tramways Co. on their acquiring lines constructed by the company. The scheme of the appellants was to acquire all existing tramways in and around Manchester and to run electric cars on the lines. The question for decision was whether the purchasing authorities (the appellants) were liable to take over from the company at a valuation the whole of the company's depôts, horses, cars and other plant used by the company over their whole system. The case for the appellants was that they were only liable to take over such depôts, &c., as within Sec. 43 of the Tramways Act, 1870, were "suitable to and used by them for the purpose of their undertaking within the districts" to be compulsory acquired. The company, on the other hand, contended that all their depôts and plant fell within the words of the Section, and that the purchasing authorities must take over the whole at a valuation. The arbitrator upheld the company's contention, and found that the company were entitled to be paid £496,068 on that footing. His alternative award if the purchasing authorities' contention was right, was that they should pay to the company £229,353. On the appeal of the purchasing authorities to Mr. Justice Bigham, that learned Judge upheld the decision of the arbitrator. The purchasing authorities then took the case to the Court of Appeal. During the arguments of counsel in February last it was decided on a suggestion from the Bench to adjourn the hearing of the appeal in order that the parties might try and come to an amicable settlement. Liberty was given to restore the appeal if they were unable to agree or to apply to get the matter in his list.

At the sitting of the Court on Monday last, Mr. Fletcher Moulton, K.C., on behalf of the Tramways Co., said the parties on both sides had taken into consideration the recommendation of their Lordships, and had come to an arrangement which, broadly speaking, meant that the Tramway Co. kept the depôts inside Manchester which were on the leased lines, and the others were taken over by the Manchester Corporation. There were certain modifications of that broad outline made by the agreement between the parties, but, by consent, he simply asked that the appeal be dismissed on terms.

Mr. Walter Ryde, on behalf of the Corporation, said he supposed that, technically, the order of the Court must be made, in order that the award might be varied.

Mr. Moulton said that the better order to make would be that, by consent, the award be varied in the manner agreed upon.

Mr. Ryde assented to that order.

Order accordingly.

Mr. Balfour Browne, K.C., Mr. Lawson Walton, K.C., and Mr. George Rhodes appeared for the appellants; and Mr. Fletcher Moulton, K.C., Mr. W. H. Aldridge, and Mr. E. T. Saunders for the company.

Chamberlain & Hookham *v.* Bradford Corporation.

The House of Lords began the hearing on Friday last of an appeal by Chamberlain & Hookham, Ltd., *v.* The Corporation of Bradford. The action was brought by the appellants for the purpose of obtaining an injunction to restrain the respondents from infringing letters patent in respect of an invention of improvements in electricity meters, parts of which improvements are applicable to dynamo-electric generators and motors, and for damages on account of profits. The respondents denied the allegation, and said the letters patent were invalid. Mr. Justice Farwell found in favour of the respondents, and the Court of Appeal affirmed his decision. The invention consisted in improvements in the form and construction of meters, which were placed on the premises which took electricity from the mains, for the purpose of registering the amount so taken. An electricity meter to meet the varying requirements of consumers, and to faithfully record the amount of electric energy supplied, must be of considerable range. It must be capable of starting and faithfully recording the energy supplied when only the minimum of electricity was used, and must at the same time faithfully record the amount of energy used when the maximum quantity required by the consumer was taken. Prior, the appellants say, to their meters, no practically or commercially useful motor-meter had ever been constructed, though various suggestions for the construction of such meters had been made. In a motor-meter in which an electric motor was made to rotate against the retarding action of a brake, consisting of a paddle working in a fluid, or of an electric disc, the following conditions were essential:—The meter must start when a minimum current was being used; it must have a commercial range; it must record accurately through its whole range; it must be constructed so that the speed was not excessive when registering the passage of the maximum consumption for which it was designed, and it must be so constructed that notwithstanding the lapse of time, the record for a given quantity of electricity would continue to be the same during the life of the meter. Mr. Hookham, in order to get rid of friction, used mercury in conjunction with a special commutator, and he further minimised the friction by the use of anti-friction wheels. The respondents alleged that they had not used either of those methods in the meters complained of. They used a form of commutator which was of an entirely different type, and was the outcome of an entirely independent discovery. The brushes of the respondents' commutator, they said, were made of silver, and the discovery that silver gave rise to very much less friction than copper was the discovery of Elihu Thomson. Further, the respondents said they had not used anti-friction wheels of any description in their meters; that their meter was nothing more than an energy meter, which had been described by Siemens prior to the date of Mr. Hookham's letters patent, altered as to the commutator in a manner totally different from that suggested by Mr. Hookham, and altered as to the brake by substituting one made of permanent magnets for the fluid brake used by Siemens, and that the particular form of the permanent magnet used in the brake by the respondents was a form well known at the date of Mr. Hookham's letters patent, and was not a form of magnet to which Mr. Hookham made, or could have made, any claim in his specification.

Mr. Astbury, K.C., opened the case for the appellants. The appellants, he said, in their statement of claim in this action complained (1) that the defendants had, subsequently to the granting of the letters patent in the statement of claim, and subsequently to the amendment of the letters patent on August 14th, 1895, and prior to the issue of the writ in this action, used electricity meters constructed in accordance with the invention disclosed in the specification of the plaintiffs' letters patents These electricity meters were constructed and operated substantially in accordance with the invention described in the specification of the plaintiffs' letters patent, and claimed in the first and third claiming clauses thereof. Particularly, the plaintiffs complained of the use by the defendants of electricity meters bearing the name of, and believed by the plaintiffs to be the construction of the Thomson-Houston Co. Such meters were used by the defendants upon circuits of constant potential for the purpose of measuring the current to a customer of the defendants. There were also other meters used by the defendants, but, so far, the plaintiffs had not sufficient information to give particulars of the infringements, but they claimed generally to recover damages in respect of all infringements of their patent by the defendants. Having explained the nature of an electricity meter, and what it was required to perform in order to be of practical utility, the learned counsel said he proposed, first of all, to go through each of the specifications of the patents which the defendants alleged had anticipated that of the plaintiffs, and under which the defendants said they were entitled to manufacture the alleged infringing electricity meters. Their Lordships would observe that in each of these the claim was for a meter of a particular kind, and not improvements to electricity meters, which was what the appellants' specification alone claimed. In the particulars of objections to the validity of the plaintiffs' letters patent, the defendants said (1) that the plaintiffs' letters patent were invalid because the specification filed in pursuance of the applica-

tion for the patent did not sufficiently describe or ascertain the nature of the invention or the manner in which the same was performed. Then the defendants went on to give the particulars of the insufficiency. They said that no sufficient directions were given to enable an electrician to make a meter which would be of any use for measuring either direct currents or alternating currents, or to enable an electrician when using an armature of constant magnetic power to produce a magnetic field which would vary in strength so as to measure currents of varying values or amounts, or to make any form of communicator, such as was necessary for a useful meter for measuring currents. Then they went on to say that the inventions claimed in the first, second, fourth and fifth claims by the plaintiffs were of no utility. The defendants next alleged that the invention claimed by the plaintiffs in the first claim was published in part in the specification of Munro, 1,626, of 1882, and they relied on the whole of that of Ayrton and Perry, 2,642 of 1882, and of Yeatman, 10,122 of 1885. The invention claimed in the first claim was also published, they said, in a paper by M. Deprez on "Siemens Energy Measurer" in *La Lumière Electrique*, a work on this subject published in 1884. Also in *Centralblatt für Elektrotechnik*, Vol. vi. They also gave particulars to show that Weston's United States Specification, 327,908, of 1885, Handford's, 2,675, of 1883, and Weston's, 330,451, of 1885, published specifications of the plaintiffs' second claim, which second claim, they said, was bad both for want of novelty and subject matter, inasmuch as electro-magnets as fully saturated as those described in the plaintiffs' specification had been commonly used, and were well known before the date of the plaintiffs' patent both in motors, brakes and meters, and their properties were well and commonly known, and there was no invention required to apply them to meters. It was bad for sufficiency of description, because no sufficient instructions were given to enable such saturation as was necessary to be obtained. The third claim of the plaintiffs' specification was bad, the defendants said, for want of novelty and subject matter, inasmuch as permanent magnets with large polar surfaces closely fronting each other had been publicly used for the purpose of procuring a powerful and constant magnetic field, and their properties were commonly understood, and there was no invention in applying them to meters. The use of such magnetics had been published in the Specifications of Siemens, 1,919, of 1872; of Elphinstone and Vincent, 332, of 1879; of Abel, 10,237, of 1884; of Yateman, 10,122, of 1885; of Blyth, 10,909, of 1885; of Carpentier and Duprez, 141,579, dated March 8th, 1881, of France; and Albert Sporel, 28,952, of 1884, of Germany; and in various publications, including Faraday's "Researches," Vol. iii., 1855, pp. 429, 353, published both in this country and abroad. Then the defendants said that by the use and exhibition in public of such magnets in Ayrton-Perry ammeters and voltmeters, and in motors and telephones, and with Arago discs at the Royal Institution, the claim for novelty was lost.

The learned counsel then dealt at length with the specifications above mentioned, and explained the way in which the defendants at trial had put their case, that these anticipated the plaintiffs' claims 1 and 3. He next read the plaintiffs' provisional and amended specifications, and said that although it had been twice amended the defendants were wrong in alleging that the specification as now printed was an amended specification claiming an invention substantially larger than, and substantially different from, the invention claimed by the specification as it stood before amendment, and on that ground was therefore invalid. He was dealing with this point on Friday, when the hearing was adjourned until Monday.

On May 4th, Mr. Astbury, continuing his argument for the appellants, said he was addressing their Lordships when the hearing was adjourned on Friday, on the question of alleged disconformity. In the specification of the letters patent of Hookham, No. 4,225**, of 1887, which were in question in the present appeal, the complete specification was down to a certain point verbatim, the same as the provisional. The complete specification had been twice amended, and it was as to the amended portions only that this defence applied. Having pointed out the amendments, and given the reasons that had led to the changes being made, the learned counsel said that properly understood Hookham's invention was for the combination and arrangement for the purposes of an electric meter of certain elements of defined character and function. He had already submitted that prior to the appellants' invention, no practical or commercially useful motor-meter—that was a meter in which an electric motor was made to rotate by electricity against the retarding action of a brake, consisting of (1) a paddle working in a fluid, or (2) of an electric disc—had ever been constructed, through various suggestions for the construction of motor-meters had been made which satisfied some of the essential conditions for construction of a successful motor-meter. Throughout the appellants' contention had been that Hookham by this specification was the first to indicate all the essential conditions. The learned counsel then turned to the grounds upon which the respondents had alleged that they had not infringed the appellants' patent. As to claim 1 they said (*a*) that the motor-meter they used could, under suitable conditions, measure the product of volts and amperes; and (*b*) that the special device for reducing the friction of the parts by which the electricity enters the moving part, which appliance was called a commutator, was not adopted by them (the respondents), but a commutator of a different construction. As to claim 3, they said that upon the true construction of the appellants' specification the claim must be limited to the special form of compound or built-up magnets illustrated in the drawings to the appellants' specification, and that they had not taken such form of built-up magnet as there illustrated. Now, in reply to the respondents' defence upon the issue of infringement, the appellants put their case as follows:—As to claim 1, the appellants pointed out that the respondents had, in fact, taken every element of the combination, and were using the meter so constructed upon a circuit of constant voltage, and were, in fact, measuring currents under such circumstances that the measure of the current was the measure of the energy supplied. The particular form of the commutator was only one alternative described in the combination, and the respondents had, in fact, taken the other alternative pointed out in the specification. Mr. Justice Wills, in the judgment he gave in the action of Hookham *v.* Johnson & Phillips, to which he should refer their Lordships later on, had held that the special form of commutator described was not an essential element of the combination.

The Lord Chancellor: Was that case on the validity and interpretation of your patent?

Mr. Astbury: Yes, my Lord; and the validity of the patent was upheld. Then, as to claim 3. The appellants pointed out that, although the special form of magnet illustrated in the drawings had not been copied by the respondents, they had, in fact, taken for the purposes of the magnetic brake of their meter a permanent magnet which was constant and powerful, and which had large polar surfaces closely fronting each other, so as to form a narrow slit in which the brake-disc revolved. At the trial before Mr. Justice Farwell, the appellants contended, as they had successfully contended before Mr. Justice Wills in the earlier action against Johnson & Phillips, that upon the true construction of the specification, the patentee was not limited to the particular form of permanent magnet illustrated in the figures to his specification. So much for the infringement. Then, as regarded the case made by the respondents which had reference to the invalidity of the appellants' patent, they did not say that if the first claim of the specification of Hookham's patent was construed to include as an essential element the special form of commutator, the first claim was invalid, nor did they allege that it was invalid if it did not, when properly construed, cover the form of motor-meter used by them, neither did they contend that if the third claim was limited to the special form of permanent magnet illustrated in the drawings that claim was invalid. But what they did allege was this, that if the appellants' specification properly construed covered what they were doing then, the appellants' patent was invalid on the grounds of want of novelty and subject matter, and in support thereof they principally relied upon the publications of Ayrton and Perry, 2,642, 1882, Able, 10,237, 1884, a description of Siemens's energy measurer by Marcel Deprez in a French paper, all of which have been with others brought before your Lordships' notice. To that the appellants replied that the documents relied on by the respondents did not disclose the appellants' patented invention; that no meter had, in fact, been disclosed under any of the alleged anticipating specifications, and that the respondents were endeavouring to anticipate the appellants' invention by constructing a mosaic of earlier matter, none of which, taken alone, would enable the appellants' invention to be made, and which, even if put together, which was not permissible, did not describe the appellants' invention. That last sentence brought the learned counsel to another point in his argument—namely, to the point that had been made against the appellants at the trial: that if the appellants' drawings were not to confine the claim to one form of apparatus which they described, but were intended, as the appellants said all along, to illustrate at once the principle and the method of combining electric motor and brake both in a constant and powerful field, and preferably both using the same field, then that no workman could from the description make such a meter by confining himself simply to the specification. That was a point which Mr. Justice Wills had dealt with in his judgment in Johnson's case, and he had decided in the appellants' favour. That learned judge had pointed out that this was emphatically a combination claim, in which all the elements described in the specification and illustrated in the drawings were to be found together. He had taken the appellants' view that these included an armature of any known type with a constant field; the use of a powerful field for the electric motor, and also for an electric or magnetic brake; the application of a permanent magnet as there described, and so on.

The learned counsel then read the judgments in the two Courts below, and also the judgment of Mr. Justice Wills in Hookham *v.* Johnson, and was still speaking when the Court adjourned.

(*To be continued.*)

Foote & Milne *v.* St. Helens Cable Co., Ltd.

Before Official Referee Mr. Verey on April 28th, 29th, &c., the plaintiffs, Messrs. Foote & Milne, electrical engineers, of 66, Victoria Street, London, sued the St. Helens Cable Co., Ltd., cable manufacturers, of Warrington, for expenses incurred and damage sustained to reputation, due to defective cables supplied to them. Mr. Spencer Bower, K.C., Mr. Hamilton, K.C., and Mr. Travers Bigham appeared for the plaintiffs; Mr. Terrell, K.C., and Mr. McConkey for the defendants.

Mr. Hamilton, in opening the case, said he hoped that it would not be necessary for himself, his learned friends, or the Referee to go into intricate details in connection with electrical science. He thought the facts were so plain that the case could be treated by business men before a business man. The plaintiffs had been and would be put to heavy expense in removing inferior cable supplied to them by the St. Helens Cable Co., and, in addition, their reputation would be seriously prejudiced and damaged by the same cause. The plaintiffs had bought from the defendants large quantities of vulcanised rubber cables intended for the purposes of electric light installation, and had relied on the warranties issued by the defendants both on their price lists and on the labels attached to

the coils. Part of these cables did not comply with the warranty, but were of inferior insulation resistance, as would be fully proved.

Counsel's opening speech took the greater part of the first day's hearing, and went fully into the dates and quantities of cable supplied and complained of. The plaintiffs had begun to trade with the St. Helens Cable Co. in 1900. The cables complained of were used either in the following jobs, or were in stock. The principal contract was the electric light of the tobacco warehouses of the Mersey Docks and Harbour Board at the Stanley Docks, Liverpool. The next largest was the wiring of the Belgrave Hospital, and there were several private houses. Something like 34 miles of cable was employed in the first contract. Mr. Hamilton then put in the defendants' price list, and explained to the Referee the various gradings of cables and the importance of the insulation. After the tobacco warehouse had been wired, the tests made were so unsatisfactory that Messrs. Foote & Milne requested that the final test should be delayed for six months. It was thought that perhaps the dampness of the buildings had something to do with the bad results, and that this might be improved by running the installation for some time. However, so many breakdowns occurred—something like 60—that when the time arrived for the final tests, the engineer of the Board condemned the whole installation and required the wires to be removed and new ones substituted. The Simplex system of conduits had been employed. Mr. Hamilton then described what appeared to be a similar state of affairs at the Belgrave Hospital, and also at a private house. Various letters had been sent to the defendants, and at length an interview with Mr. Heyl-Dia, the then managing director of the St. Helens Cable Co., was arranged. It was then agreed that the cables sent to the plaintiffs should be specially tested, and that all care should be taken therewith. In spite of this, however, certain of the cables sent for replacement proved unsatisfactory. Affairs had now grown very serious, and on February 3rd, 1902, another interview with Mr. Heyl-Dia took place, and the following agreement was entered into, which was afterwards confirmed by letter and telegrams:—"That new cable should be sent to replace what they already had. That the old cable should be returned in batches, and that the cable to replace these should be sent within a week, and that it should be tested after 24 hours in water, and that each coil should have a label certifying the result obtained at the defendants' cost, also these cables were to be tested by plaintiffs, and also 10 per cent. of the coils at Faraday House. In the event of any of the coils not coming up to the tests, the defendants were to pay the value of all cable that the plaintiffs still had. The defendants were to pay £120 expenses incurred up to the 30th ult.; and also all other costs incurred through using the faulty wire supplied to plaintiffs, these including 15 per cent. for establishment charges. Vouchers were to be supplied, and disputes settled by an independent accountant. No dispute, however, to be an excuse for deferring payment. When other make of cable had to be used, this was to be paid for at its value, not at the value of the cable replaced." The agreement further provided that should any of these conditions be unfulfilled, it should be cancelled, and that plaintiffs should be free to make claim for damaged reputation and expenses incurred. After the agreement had been in force and various payments made under it, disputes occurred, and finally on March 17th, 1902, the defendants repudiated the agreement. By reason of this the plaintiffs suffered damage:—(1) For cables they have returned or have in stock, £312 5s. 8d.; (2) for work done in replacing faulty cables up to May 27th, 1902, £147 4s. 2d.; (3) various other costs and expenses in connection with defendants' cables at various jobs, £65 2s. 2d.; (4) estimated cost of rewiring tobacco warehouse, £2,550; (5) damage to their business reputation, £3,000. The sum of £100 8s. 4d. is due to defendants from plaintiffs, and is admitted.

Mr. Milne, partner in the plaintiffs' firm, gave evidence with regard to the lengthy correspondence put into Court. He also identified a number of warranty labels attached to coils of defective cables. With regard to the interview with Mr. Heyl-Dia, he was perfectly certain that the Liverpool job had been mentioned as one of the heaviest items, and he was convinced that Mr. Heyl-Dia had appreciated both the extent of the probable expense and the damage done to their firm, and that his remarks about making the damage good took in this point also. As regards the conversation about the faulty cables, he remembered very well their import, and particularly one remark of Mr Heyl-Dia's, who had said in connection with the percentage of good cables:—"We can turn out some good cables, at least."

Resuming on 29th ult., Mr. Milne continued his evidence' Twenty-three of the coils in replacement were sent to Faraday House on January 24th, 1902. Five of these coils were good (1,200 megohms), and 18 were very bad, far under the warranty of 800. He himself had tested 240 coils supplied for replacement purposes in March, 1902; 105 were bad, and the remaining 135 had at least passed his testing instrument, which only read up to 250 Ω per mile. These coils were tested as received from the St. Helens Co. Mr. Lyster, chief engineer, along with Mr. Taplin, electrical engineer, and his assistant, were superintending the installation. Mr. Lyster had written complaining of the inferior rubber. Twenty-nine coils supplied to Belgrave Hospital, and specially tested and warranted, were sent to Faraday House. Of these 25 were bad, and four good. These coils had not been used. Mr. Milne then tendered some evidence with regard to the damage sustained to plaintiffs' reputation.

Cross-examined by Mr. McConkey, Mr. Milne stated that Mr. Owen had become a partner in January, 1901. The business had been turned into a limited liability company in May, 1902. The limited company were to take over all that was recovered in this case. Questioned with regard to his inspection of cables supplied to the Liverpool job, he said that he had at least examined 20 to 50 of the coils and their labels, and that the warranty was never under what was put forth in the price list. His foreman, however, would examine all of the labels. Questions were then put in connection with the specification of the Dock Board and the specification of a former job in the neighbourhood carried out by the company with St. Helens Cable, which job had been passed. Mr. Milne replied that both specifications were practically similar, and the manner of carrying out the same. The 300-grade cable would be employed where the warranted insulation was 600 per mile, and the 600-grade where the 300-grade did not come up to the guarantee. The Simplex system used was a split steel tube. In his opinion it was not the cheapest, as he thought casing was as cheap, or even cheaper. As regards samples submitted to the Dock Board, these would be of St. Helens make, and similar to what was being put in. Foote & Milne had been in existence for five or six years. He himself had been connected with the trade for 20 years. Questioned with regard to the rubber used, he did not think six months' damp atmosphere should affect it. It should stand at least six years' exposure. The rubber had not a good appearance, being brittle, although the cables varied greatly in appearance. He had relied on the warranty in spite of this. Mr. Milne admitted that a little of Frankenburg's cable was used in the job, but thought it extremely improbable that any other maker's cable could have been used. The Frankenburg cable was better in appearance.

Mr. MacConkey then attempted to show the probability of some rubberless cable having been used in the wiring, because some of this had been returned to the St. Helens Cable Co. by the plaintiffs when returning the faulty cable from their stock, but Mr. Milne would not admit the faintest probability of this, and pointed out how many hands it had to go through before being used. The job would have been a paying one, but for the faulty cable supplied.

Questions were then put as regards the cables being near wet concrete, the answer being that while the concrete might have been damp it was not dripping wet. The tubes were threaded on to the cable, being cut to size before that. The first written complaint to the St. Helens Cable Co. was made on August 21st, 1901. The re-wiring began in July of 1902 with Henley cable. The results obtained might have been low, but no breakdown occurred.

On resuming on the 30th ult., the cross-examination of Mr. Milne was continued. He stated that all the other jobs, with the exception of the Liverpool one, were carried out under the superintendence of Mr. Dove, who would make verbal reports. The Liverpool reports were in writing. Robinson had written saying that he thought the tubing might be too tight; but apparently on trial he had found it not to be the case. Some rust had shown itself on the tubing after being put up, and painting it had been suggested. He considered the system of split tubes equally as good as barrel. As for rust affecting the rubber, he had used miles of rubber-insulated cable in rusty gas barrel with no bad result. Mr. Milne was then taken over some of Robinson's correspondence with the firm. The ends of the Simplex tubing had apparently got bent and some inches had to be cut off. On July 15th, 1902, Robinson had got a dead earth, and had used a somewhat ambiguous phrase with regard to it. Another point taken was the looseness of some of the lids of the junction boxes. The Frankenburg cable used was all right. It was both taped and braided, and had given no cause for complaint. It was pulled out, as no note had been taken of where it was, it having been used here and there. The re-wiring done by the Dock Board had been left in because it was known where it was. They had made no claim on Frankenburg. Robinson in writing his firm had asked whether they wished the use of the Frankenburg cable on the job kept quiet, and Mr. Milne explained that at that time they were considering their position with their solicitors, with the result that no attempt at secrecy had been made. After being laid the tests gave results good enough to go on with. There were a few breakdowns caused by what had been ascribed to malicious damage. Robinson had come across 10 places cut. Some of the tubing in re-wiring had been taken down at the bends, but merely to allow the cable to be withdrawn. With regard to the other jobs mentioned in the particulars, St. Helens cable was used in each. Mr. Milne was then questioned with regard to the London manager of the St. Helens Cable Co. He stated that he had thought Mr. Holmes to be the manager, but at the end of 1901 he discovered that Mr. Smith, a representative of a competing firm, Drake and Gorham, was the real manager. He had made complaints to him then, and had actually tested a St. Helens cable along with him, which turned out to be bad.

At this point Mr. Marchant, D.Sc. (London), Professor of Electrotechnics at University College, Liverpool, was interposed. He stated that he had tested the coils sent him by the Mersey Dock Board. He had repaired all the mechanical injuries, and 18 coils were then tested after 24 hours' immersion in water. Two of these coils gave 27,000 and 35,000 [megohms?], and he considered these to be fair; two with 210,000 and 290,000 he considered satisfactory; of the remaining 14, all were unsatisfactory, some only showing thousandths of a megohm. Forty coils had also been sent to him for testing. He had followed precisely the same course with these. (After-evidence was given that of these 40 coils, some were Frankenburg's and the others St. Helens. As without giving the tables of tests, reference to the identifying labels would be useless, it might be well to state that the Frankenburg cables, with but one exception, gave good results, the majority of the remaining cables proving unsatisfactory.)

Cross-examined by Mr. Terrell, he had no knowledge of the rubber manufacture. He considered that a lower-grade cable was inferior in lasting properties to a higher-grade cable, and that the former, while proving satisfactory in a dry place, might be unsatisfactory in a damp one. He declined to say whether prolonged subjection to a damp atmosphere would hasten deterioration. In

his tests he had taken 1,000 megohms per mile as his opinion of a good resistance. He was then taken in detail over his tests. His examination of the cables for mechanical injuries had been visual. Whenever he saw bruising of the braid, he had suspected injury, and had paraffined it. The faults might either have been due to bad manufacture, or to bad usage. Asked if he knew that the rubber for insulation purposes contained over 50 per cent. of pigment, he replied that he had heard so. Questions were then put with regard to the rubber, which were answered so hesitatingly that plaintiffs' counsel urged witness, in fairness to both sides, to decline to answer any question he was not competent to give an opinion on, advice which witness accepted. It was possible the defects might have been caused in the 40 samples by pulling them from the tubes, but he was not prepared to say that their six months' exposure to a damp atmosphere would have been the cause.

Dr. Marchant's re-examination took the form of showing how easy it was to suggest any number of unlikely things which might have produced the faults, but which, counsel put it to him, did not do so.

Mr. TAYLOR, representative of a fire insurance company, which had insured the tobacco warehouses, was then examined. He had visited the job during the course of the work, had reported upon it, and had passed it.

Mr. MABBS, manager of the cable department of Messrs. Frankenburg's, from 1897 to early in 1903, stated that he was sent to the Mersey Dock to identify, out of 40 samples, those that were Frankenburg's. He identified over 20 of these. (These are the samples reported upon by Dr. Marchant.) The insulation of some of the remaining samples he condemned.

Cross-examined, he stated that he did not prepare the rubber for the cable work, this being done by another department. The rubber used in the 600 megohm grade would contain about 45 per cent. of pigment, and the 300 grade, about 5 per cent. more. The elasticity of the rubber was of importance, and the purer the rubber the more durable it would be. Questioned as to what was the matter with the remainder of the 40 samples which were not of his make, witness replied that the rubber was decomposed and in a treacly condition. As regards what pigments were used, he was not going to give away any secrets. He was here to give evidence as regards identifying certain samples. He was certain that six months' exposure to damp would not cause deterioration of any good insulation. Except for flexible cables, never a yard was sold by Frankenburg but what was their own make.

On resuming on May 1st, Mr. Mabbs identified the samples, and the cross-examination of Mr. MILNE was continued by Mr. TERRELL. There was about 8 miles of Frankenburg cable used, in value about £165. It was used indiscriminately. The Dock Board would not allow any circuit to remain, but insisted on the whole being pulled out. He had not known until lately that any Frankenburg cable had been used at all in the job. He had made no claim on Frankenburg, as their cable had tested above warranty. Re-examined, he stated that he had done all in his power to get the Dock Board to let the St. Helens cable remain. There had been no complaint of workmanship, but, on the contrary, rather flattering remarks. The job was re-wired with Henley cable, in precisely the same manner, completed to the satisfaction of the officials, and the retention money had been paid. The wire pulled out was only of the value, to him, of scrap wire, probably about £16 per ton. Some modifications of the wiring had been made, and Mr. Milne mentioned that he considered it fair that for these he should allow the defendants £15.

Questions had been previously raised with regard to some of the wire sent back to the St. Helens Co. from Foote & Milne being not of the former's manufacture, and Mr. MILNE now gave evidence that, before being sent back, it was all identified and measured up by Mr. A. G. Holmes, the defendants' storekeeper.

By permission, Mr. MILNE was again cross-examined, and gave details of the tests made on the smaller jobs. Most of the wiring had to be pulled out and new wires put in. The Belgrave Hospital had to be entirely re-wired with cable of another make. This was, of course, after Mr. Jackson, an employé of the defendants, had tested the cables and found the insulation resistance very low. It was 600 grade, in gas barrel. Henley wire of the same grade was used in re-wiring.

Mr. A. H. TAPLIN, electrical engineer to the Mersey Harbour Board, was then examined. The tobacco warehouse installation had been done under his supervision. He had approved of the system and workmanship. He first began to notice anything wrong when the work was put into commission. The faults were pointed out, mainly very low insulation and dead earths, and the balance of the account was withheld. The faults pointed to the bad character of the insulation, and he then examined the rubber and found it inferior to that of other makes. They were asked to let the plaintiffs bring the circuits up if possible, but this was refused. Letters then passed between them. The plaintiffs wrote, frankly stating that while they thought the insulation was at fault, yet they were of opinion that pinholes being likely to be the cause, these would all be found out. The reply was that the whole of the material must be removed and new cable substituted. The Dock Board took exception to the name of the St. Helens Cable Co. upon the list of manufacturers of cable for the re-wiring. The re-wiring with the Henley cable was satisfactory. The same system of barrels was used, but, of course, the cable in the re-wiring had to be drawn through. No complaint of the workmanship of the first wiring had ever been made. The witness then gave evidence with regard to the 40 samples tested by Dr. Marchant.

Cross-examined by Mr. TERRELL, WITNESS stated that the contract specified for 600-megohm insulation resistance per mile. He understood by that term that 600-megohm grade cable was implied. If he had known that the contractors were using 300-megohm grade cable he would not have been satisfied. He had not known that. He understood that the higher grade cost more, had a higher insulation, and greater durability. The first tests he made were in the beginning of 1901. Some of these were satisfactory, but not all. He had not objected, in the hopes that it would improve. He had no recollection of supplying Mr. Taylor with reports of tests. The tests were made after the current was switched on. In the November of 1901 a number of breakdowns occurred. He located the faults and remedied them, but these got so numerous that he began to look into the insulation. He found the rubber "short," but not knowing whether it was all like that, he hesitated to report until April 28th. Questioned as to whether all was bad, witness replied that the offices were good, but fearing the rubber, they insisted on these being re-wired also. No complaints had been made of the fittings, except minor ones. He had not noticed that the old wire was tight in the tubes, and he did not consider the faults were due to mechanical injury. They had re-wired about four miles of the job here and there. Witness was again asked and repeated that what he considered was meant by a cable of 600-megohm insulation resistance per mile was a 600-megohm grade cable.

Re-examined, Mr. TAPLIN stated that if the cables had had an insulation resistance of 600 megohms per mile he would have accepted them. The Henley cable had been drawn through, but no damage had resulted.

Mr. MILNE was again recalled and questioned as to his tests. He was asked if he would be surprised to learn that no maker will guarantee a 300-megohm grade cable for six months. He replied that he would be greatly surprised. He had found out that the 300-grade cable did not come up to warranty on January 29th, 1902.

Mr. ROBINSON, the foreman electrician of Messrs. Foote and Milne, at the Liverpool job, was the next witness. He stated that the tube was threaded upon the cable. It was never tight to thread, but naturally would be tighter when drawn, though there was no trouble in drawing in the new cable. It had not been injured in putting on the tube. The Simplex tubing had been fixed with the slit downwards. The floors were tested separately, and at first were good enough, but gradually got bad, varying greatly. There were very few bends of any kind, and all the joints were tees, and laid in junction boxes. Special precautions were taken to prevent the barrel resting on the wire.

On resuming on May 4th, Mr. ROBINSON made special mention of 3 drums of 37/13 wire sent direct to Liverpool from Warrington. This was of special size, and no Frankenburg cable was joined to it. These tested well at first, but dropped after. He had only been away from the job for two weeks altogether. No change was made in fixing the Henley cable. He had seen and tested the wiring in most of the other jobs, and found good work, but faulty cable.

Cross-examined by Mr. TERRELL, he stated that he could scarcely say he knew the details of the grading of cables. Lead-covered cable would be used in the dampest places, he presumed, to protect the rubber from the moisture. As regards his ideas about using a larger size of tube, he thought it might save labour. Upon testing the cable and tube for size, however, it would appear as though he had been satisfied with the 1¼-in. tubing as it eventually had been used. No damage had been done to the cable. As regards the assistance that he had had, he considered that he had enough wiremen on the job. His remarks about the job costing more than had been bargained for, applied solely to the price given him by Mr. Milne as to what he should try to keep it to. He had naturally tried to work it as economically as possible, but not to the detriment of the work. He did not know the prices of the material, and he did not think the grade of wire used was unfitted for the work. The fittings were substantial, and of the average value. He had put the trouble down to dampness in the switches at first, and for that reason had suggested running the installation for six months. Further results, however, showed that the cable was in fault.

Re-examined, he stated that there was only the usual amount of moisture in the new buildings, and they could not by any means be said to be dripping with moisture. The switches and fittings were good. The tubing was large enough to take in another wire or two.

Mr. RADCLIFFE, assistant electrician to the Mersey Dock Board, was the next witness. He had been on the job all the time, and had approved of the materials and work. The switches were perfectly good and approved of. Over 60 breakdowns had occurred. Three of these might have been due to other causes, but the rest he put down to bad insulation. The majority of these were in short runs. The special sizes of wire sent on three drums direct to St. Helens he remembered. Two of these became dead earth, the third was so poor that it had to be withdrawn. He had a test of the rubber on the same samples as were sent to Dr. Marchant to be tested electrically. The one test was to expose the rubber for one hour to a dry heat of 270° F. The second was to put it under a pressure of damp steam of 50 lbs. to the sq. in. for one hour. If the rubber perished he considered it bad, if it survived he considered it good. The majority of the Frankenburg samples of rubber stood the tests. The majority of the St. Helens did not stand the tests.

Cross-examined by Mr. TERRELL: This was his first experience of testing rubber. He knew little about it, and could not say whether the percentage of sulphur would, under this test, make all the difference as to whether the rubber showed good or bad. Questioned as regards the grades of cable, he said he understood that the higher grades had the better insulation. The warranty labels on the cables delivered, however, showed from 1,100 to 1,200 megohms insulation, and he relied upon that. He had known that Frankenburg's cable was being used here and there. Witness then gave details of his tests which showed that only three

floors had come up to the insulation resistance required. In the smaller sizes there was no 600-grade wire used.

Mr. H. C. Silver, of Faraday House, gave evidence of the testing of 23 coils on January 29th, 1902. Some were good and some were bad. Resistance varied greatly, some being as low as $\frac{1}{100000}$ of a megohm per mile.

Cross-examined by Mr. Terrell, Witness declined to admit that the meaning of the phrase, "an insulation resistance of 600 megohms per mile" meant necessarily a 600-grade cable. It meant exactly what it said. He declined to enter into a discussion as regards rubber, as he had no practical knowledge of the subject. The tests had been made in the usual manner, with the usual precaution, after 24 hours' immersion in water.

(To be continued.)

Blower *v.* Roberts.

A partnership action of interest to the electrical trade was heard before Mr. Justice Farwell, on Thursday and Friday last week, in one of the Chancery Courts.

Mr. E. Beaumont, in opening the case, stated that the plaintiff, Mr. Arthur Ernest Blower, was formerly a member of the firm of Ernest Roberts & Blower, carrying on business as electrical engineers at 6, Holborn Place, and he claimed that he was a partner in that firm from October 1st, 1901, to November 8th, 1902, and that he was entitled to half the profits of the business during that period.

Mr. Cozens-Hardy, instructed by Messrs. Nicholson & Crouch, stated that the defendant, Mr. Ernest Roberts, denied that this was the arrangement, and contended that the plaintiff was only entitled to a share in the profits for the period of five weeks from October 1st, 1902, to November 8th, 1902.

Mr. Blower in his evidence stated that for some years prior to October, 1901, he had been with the Edison & Swan Co., but that in September, 1901, he entered into an arrangement with Mr. Roberts to join him as partner on the terms that the profits of the business should be divided equally between them as from October 1st, 1901, and that Mr. Blower should expend the sum of £200 out of his own money in travelling for the firm for the first year of the partnership, at the end of which time such £200 was to be credited to Mr. Blower as his capital in the firm. He stated that in consequence of this agreement he left the Edison & Swan Co. and joined the defendant, that after October 1st, 1901, the business was carried on under the style of "Ernest Roberts & Blower," that the notepaper and invoices were altered into the firm's name shortly after that date, and that letters and orders were signed in the name of the firm. Copies of the Electrical Review and other electrical papers for October, 1901, containing notices of the commencement of the partnership were produced. Evidence was given by witnesses to whom the plaintiff had been introduced as partner as establishing the fact of the partnership.

The defendant, Mr. Ernest Roberts, gave evidence in support of his case. He admitted, in answer to a question put by the judge, that the effect of his contention was that the plaintiff was to give to the defendant the benefit of his connection for one year, and to receive nothing in return either by way of profit or remuneration.

The Judge, without calling upon Mr. Beaumont to reply, and after stating that he believed the plaintiff's story, and not that of the defendant, gave judgment, with costs, for the plaintiff, and directed that the plaintiff should have 14 days in which to decide whether he would accept a sum of money which had been paid into Court in satisfaction of his claim, or whether there should be taken the strict account to which he was entitled.

British Thomson-Houston Co. Ltd., *v.* The Mayor and Corporation of Manchester.

In the Chancery Division of the High Court of Justice on Wednesday, Mr. Justice Buckley had opened before him an action by the British Thomson-Houston Co., Ltd., claiming an injunction to restrain the Corporation of Manchester, their servants and agents, from infringing certain electrical patents which are of special importance in the working of electric cars. By their statement of claim, plaintiffs described themselves as the registered legal owners of Letters Patent No. 6,063A, of 1889, granted to Henry Harris Lake for an invention of "Improvements in and relating to electric spark rupturing appliances," and of Letters Patent, No. 13,920, of 1892, granted to Walter H. Knight and William B. Potter for an invention of "Improvements in methods of regulating electrically-driven mechanism and apparatus for putting the same into operation." The specifications of both the letters patent had been duly amended. Defendants, it was represented, were using upon their tramways at Manchester "controllers" for controlling the motors on their electric cars. Such apparatus was constructed for the defendants by Dick, Kerr & Co., and plaintiffs alleged that so far as it related to the magnetic blow-out infringed claim 1 of Letters Patent, 6,063, 1889, and claim 3 of Letters Patent, 13,920, 1892. Such apparatus so far as it related to the changing from series to parallel infringed claims 1 and 2 of Letters Patent, 13,920.

The main defence of the Manchester Corporation was that there was no subject matter in the plaintiffs' invention. Defendants also denied infringement. They alleged that the invention had been published in this realm prior to the date of the Letters Patent by the specifications of the following Letters Patent:—No. 1,438, granted in 1874 to Richard Werdermann; No. 853, granted in 1879 to Charles Denton Abel; by No. 2,321, granted in 1879 to Joseph W. F. Andrews; by No. 10,600, of 1886, granted to John E. Rogerson, and others; by No. 5,704, 1888, granted to John S. Raworth; by 283,167, U.S.A., of 1883, granted to Elihu Thomson; by 321,464, U.S.A., of 1885, granted to Elihu Thomson; by the publication of the following papers and books:—John Tyndall, "Researches on Diamagnetism," pages 274 and 275, published in 1870; De la Rive, "Treatise on Electricity," page 296, *et seq*, published in 1856; Edwin J. Houston's paper in the *Journal of the Franklin Institute*, Vol. 93, page 299, published in 1872; and the Encyclopædia Britannica edition, 1879, Vol. 8, page 74, paragraph 3, and fig. 44. The particulars of objection further set forth that it was common practice in all lightning arresters or arc-rupturing devices to interpose an insulating material between the electrodes of such device and any neighbouring metallic or conducting material. Having regard to the state of the public knowledge at the date of the Letters Patent as to the use of magnetic arc-rupturing devices having the two electrodes placed in a magnetic field, so that the magnetic field operated to blow out the arc, and as to the use of insulating material to prevent a current passing, or an arc striking between the two neighbouring conductors, and having regard also to the information disclosed by the publications and user set out, defendants pleaded that the letters patent disclosed nothing that required invention or that was the proper subject matter for the grant of letters patent.

It was intimated at the opening of the case that although the plaintiffs had originally brought their action in respect of two patents, notice had been given of discontinuance of proceedings in regard to Letters Patent No. 13,920 of 1892, granted in 1892 to Walter H. Knight and William B. Potter, and that the only patent on which plaintiffs now relied was No. 6,063A of 1889, granted to Henry Harris Lake.

Mr. Fletcher Moulton then commenced his opening speech.

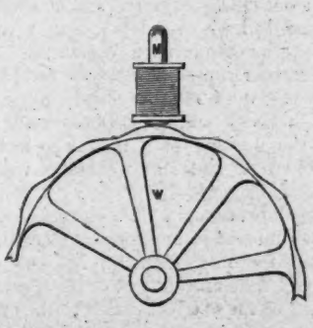
Mr. Fletcher Moulton, K.C., Mr. Bousfield, K.C., Mr. J. C. Graham, and Mr. A. J. Walter appeared for the plaintiffs; and Mr. Cripps, K.C., Mr. T. Terrell, K.C., and Mr. A. B. Shore for the defendants.

(To be continued.)

CORRESPONDENCE.

Electrical Micrometry.

The arrangement which you already have proposed in reply to "W. A. T." appears to be very wisely planned; a small condenser and a telephonic buzzer should serve the purpose; only, instead of the ordinary form of buzzer, I wish to suggest a new device which I recently submitted to the National Telephone Co. In the accompanying sketch is shown a permanent magnet, M, wound with fine wires, and a wheel, W, which rotates in front of the poles of magnet M. The rim of the wheel is of soft iron, and cut



out as shown; it forms a movable armature, which approach and recede from the poles of the magnet, thus causing variations in the resistance of the magnetic circuit. This, of course, varies the number of lines of force, and an alternate current is produced in the coils. The variation of the induced current will be sufficiently great to work a trumpet receiver.

G. C. Geisler.

Ealing, W., *May 4th*, 1903.

[We are obliged for our correspondent's approbation; but we fear he is mistaken in supposing that there is novelty in the device which he describes.—Eds. Elec. Rev.]

Cassel Water Wheels.

My attention has been called to a notice which appeared in your issue of last week on the subject of the Cassel Self-regulating Water Wheels, in which the guarantee of regulation in the Cassel water wheel was stated to be a variation

not exceeding 33 per cent. in the speed when the load was reduced suddenly from full load to no load or *vice versâ*.

To anyone who has had experience of the performance of the Cassel wheel, the figure 33 is at once seen to be a printer's error, but as there are numerous water motors in existence the variation in speed of which will certainly exceed this figure upon full load being suddenly thrown off, a false impression may have been conveyed to some of your readers. May I, therefore, be permitted to draw attention to this printer's error and state that the company's guarantee is a variation of speed not exceeding *three* per cent. when the load is instantly reduced from full load to nothing, and that the wheels referred to in the pamphlet you commented upon are stated by their users to keep within 2 per cent. of normal speed under the above-mentioned variation of load.

Ed. C. de Segundo,

Consulting Engineer to the Cassel Self-regulating Water Wheels, Ltd.

Consulting Engineers.

I have read the interesting letters which have recently appeared in your columns upon the subject of "Consulting Engineers."

Mr. Hal Williams sums up the matter very concisely in the concluding paragraph of his letter which appears in the current issue of your journal.

I think that most of us are agreed as to what a consulting engineer *should* be, but, unfortunately, the designation "Consulting Engineer" has been, and still is, so much abused by unscrupulous people, that the term "Consulting Engineer" engenders suspicion rather than confidence. For instance, on page 726 of the ELECTRICAL REVIEW this week, in the second paragraph of your article headed "Electricity and Mines," a gentleman is referred to as "Consulting Engineer and Contractor." This is by no means an isolated instance; I have seen the letter paper of more than one firm headed in the same way. Now, what position can a "Consulting Engineer and Contractor" be expected to take up towards his client, or his employer? The difficulty of divided or conflicting interests has been recognised since very early days; it is graphically dealt with in the Bible in connection with the question of serving two masters.

I do not suggest that it is impossible for a man to act at one time as a consulting engineer and at another time as a contractor, nor do I wish to suggest that a consulting engineer is a superior being to a contractor. It is certainly immaterial whether you make a profit by the work of your brain or by the work of your hands, provided always—as lawyers say—that the profit is honestly made; but I cannot understand the position of a man who advises his clients upon certain work and then contracts with him for the carrying out of the work.

What would be thought of a physician who had a pecuniary or other interest in any form of medicine or drug that he prescribed for his patient? No one can deny that circumstances might arise in which the particular medicine or drug *might* be the one best suited to the exigencies of the case; indeed, the argument has been advanced that the man who is in the habit of carrying out the work (the contractor) is better qualified to advise upon such work than the consulting engineer whose occupation is admittedly limited to advising upon, but not actually carrying out, engineering work, and to a limited extent this is quite true. For example, I would rather trust a foreman erector of a firm of engine builders to line up and erect a steam dynamo, than the average consulting engineer, but when it came to the choice of a type of steam dynamo for any special purpose I would trust the consulting engineer who had had experience of the performance of various types of steam dynamo to select the one best suited to his client's requirements rather than the traveller, or manager, or other official of a steam dynamo manufacturing firm who would get a commission if his steam dynamo were used, and to whose interest it therefore would be to sell his steam dynamo, irrespective of whether it will turn out to be the best or most economical or most satisfactory in the circumstances.

The contractor is, and must be, first of all a *business* man, that is to say, it is his business to *sell* his goods, and to that end it is his business to claim for his particular manufactures a degree of excellence superior to that of his trade rivals. It is well known that competition in trade has brought about a state of things which was summed up by Emerson in the following words:—"The ways of trade are grown selfish to the borders of theft, and supple to the borders (if not beyond the borders) of fraud."

Now, to a client, the whole value of a consulting engineer is, that he should be absolutely untrammelled by trade considerations in formulating his views. If he is not, he is something like a badly constructed lightning conductor, an apparent source of protection, but in reality a dangerous appendage.

It is no doubt largely due to the comparatively recent evolution of engineering into the status of a profession, that consulting engineers (in the real sense of the word) have not sought to protect themselves and their position in the professional world in a manner similar to that which has been adopted by the medical and other professions. As things stand, anyone can put the letters "C.E." or "Consulting Engineer" after his name on his brass plate, and the unwary client is thereby lulled into a sense of false security.

I am quite aware that a possible answer to this suggestion is that in this respect the advice *caveat emptor* applies, and that however much one may seek to hedge a professional man by restrictions, it is impossible to formulate any code that will effectually prevent a man from being unscrupulous should this be his nature. At the same time a man always has a certain wholesome respect for his bread and butter, and if the term "consulting engineer," were only applicable by law to a man who had shown himself to be worthy the title—both technically and morally—and were it an offence punishable by dismissal from the ranks of professional men for a consulting engineer to be pecuniarily interested either directly or indirectly in the work upon which he advises, except to the extent of the fee payable by his client, I think the number of consulting engineers would suffer an immediate and very marked diminution. I have no doubt in the world that all this will eventually come to pass. The medical profession has struggled through exactly the same stage of development, and so, practically, have all other professions. But now that engineering has been shown to be capable of highly scientific development, and, therefore, to be a profession of which highly educated and experienced practical and scientific men need not be ashamed, it seems a pity to delay taking steps which the history of the evolution of other professions has shown to be absolutely essential for the establishment and maintenance of a high standard of excellence and integrity.

Ed. C. de Segundo.

Municipal Loans.

I must leave it for your readers to decide for themselves whether a contention which you try to uphold should need illogical argument to back it up, if there is any soundness about it at all; and also, leave to their imagination your sinking fund, which one week makes it possible when the whole loan is paid off, to renew plant without any further depreciation fund, and the next week "in no way acts as a depreciation fund." Also, how one week a fallacy that no valuable asset remains when the loan is paid off, changes the following week to "30-year old plant, is not as good as new," although there is a certain small portion of it still worth something; and, lastly, how a piece of land is protected against floods, when the river, every time it rises, is allowed to inundate it. It seems to me futile to further discuss the matter, as it is impossible without a logical argument to come to a logical proof of your contention, and that is what you do not seem to be able to give.

David Smith.

London, *May 4th*, 1903.

[Our correspondent's ingenuity in misrepresenting our statements is worthy of a better cause. Our position with regard to the sinking fund is perfectly consistent; it is intended solely to pay off a debt, and *must* be paid. A depreciation fund is intended to replace worn-out and obsolete plant without incurring a new debt; those who

prefer to wallow in debt make no allowance for depreciation. The fallacy that we are tired of pointing out has in no way changed; we repeat what we have said:—"We attach no value to obsolete plant." "The fallacy is that 30-year old plant is as good as new." (Surely 30-year old plant is obsolete?) "No valuable asset remains when the loan is paid off." Where is the discrepancy?

We are pleased, however, that Mr. Smith has grasped the point of our parable so clearly; it was precisely our object to show that the protection afforded by a sinking fund without a depreciation fund, for the credit of a community, was no better than that afforded by pumps without dykes for the protection of land against the effect of floods (not against floods, as Mr. Smith misquotes). Our correspondent has not attempted to answer our points; he takes fresh ground each week, and ends with a gibe. But is this "logical argument"? We agree that it is futile to discuss the matter—with Mr. Smith.—Eds. Elec. Rev.]

Depreciation of Plant.

We have recently installed in our printing works in London a three 100-kw. direct-current, 200-volt combined power and lighting plant. We use water-tube boilers and compound high-speed engines, running at 160 lbs. boiler pressure, with a moderate superheat (100° F.).

We employ a staff of skilled engineers, and the plant is kept in good order, all repairs being charged to working expenses.

We are uncertain as to the correct percentage which we ought to allow on this plant for depreciation, and we should be obliged if you or your readers would express an opinion as to the number of years in which the plant should be entirely written off.

Printer.

[Such a question is very difficult to answer. If our correspondent refers only to the life of the generating plant, 20 years would, in our opinion, be a fair period to allow; but the shorter life of the wiring and motors, the possibility of great advances in gas engines and turbines, and of power being supplied at very low prices, all tend to accelerate the arrival of the day when, although not worn out, the plant will become valueless to its owner.—Eds. Elec. Rev.]

Electric Ignition in Gas Motors.

I thank you for inserting my letter of last week, but in reference to your remarks thereon, may I point out that the patent referred to relates shortly to the *addition* of an *artificial* capacity to the secondary circuit, and to the sparking plug of internal combustion engines. This may seem a small matter, but it indisputably produces a greatly improved result; while the fact remains that prior to the date of this patent (1901), motorists and the trade had been going on without anything at all of the kind, and are only now commencing to awake to the great advantages of the addition.

In regard to the second item—to those who have a liking for violent electric shocks, and for being "skied" by mixtures of stray sparks and petrol vapour, I heartily commend the use of lead-covered cable as a means of connecting the various parts of their high-tension circuits.

A. C. Brown.

London, *May 5th*, 1903.

Experiments with a High-Pressure Fuse.

With reference to Mr. Garrard's recent article and letter on the above, we would like to make the following suggestion:—

Unless something unforeseen happens, our second 5,000-h.p. 11,000-volt steam generator will be ready for running at Willesden in about 10 weeks, and, presumably, by this time the new switchboard for controlling the two plants will be ready for operation.

We suggest that Mr. Garrard should support his assertions with regard to the absolute reliability of the Ferranti fuse in question by testing it once more, giving it this time, however, a severe test; this test to take the form of throwing the two machines (previously excited to give 11,000 volts each) into parallel when they are in opposition of phase—say, two or three times; the results of this test, whether good or bad, to be published in full in the Review directly afterwards.

We will undertake that our plants will stand this test all right, and will take all responsibility in connection with them; Mr. Garrard, however, would have to take all responsibility in connection with the switchboard.

The test in question would, of course, have to be made subject to the consent of the Metropolitan Co., which consent Messrs. Ferranti could probably easily obtain.

Witting Bros., Elec. Eng. and Cont., Ltd.
A. C. Eborall, *Technical Director.*

London, *May 5th*, 1903.

Information Wanted.—A correspondent would be glad to hear of any large electric motor-driven pumps installed at waterworks in this country for town water supply—*not* centrifugal pumps.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending May 6th, 1902.		Week ending May 5th, 1903.	
Adelaide	Value £513	Adelaide	Value £218
Alexandria	74	Alexandria	286
Amsterdam	75	„ Teleg. mat.	15
Bangkok	100	Amsterdam	139
Bombay	72	Bangkok	40
Buenos Ayres. Teleg. mat.	343	Batavia	20
Calcutta	260	Bombay	10
„ Teleg. wire	24	Boulogne	20
Cape Town	372	Brisbane	14
Christiania. Teleg. wire	27	Calcutta	891
Colombo	324	Cape Town	883
Cooktown	24	Colombo	95
Copenhagen. Teleg. wire	51	„ Teleg. mat.	177
Durban	4,045	Delagoa Bay	33
Fremantle	55	Durban	192
Hong Kong	16	„ Teleg. mat.	525
Melbourne	120	„ Teleg. wire	3,260
Perth	775	East London	22
Port Elizabeth	22	Flushing	20
Rockhampton	20	Hamburg. Teleg. mat.	250
Sydney	561	Larache	25
Tokio	48	Lyttleton	14
Valparaiso	107	Madras	53
Wellington	42	Mauritius	61
		Melbourne	25
		Perth	62
		Port Elizabeth	90
		Rotterdam. Teleg. wire	52
		Santos	1,184
		Shanghai	104
		Singapore Teleg. mat.	114
		Stockholm	30
		Sydney	95
		Tientsin. Teleg. cable	90
		Vera Cruz	801
Total	£8,330	Total	£9,402

Foreign Goods Transhipped.

Bombay. Telephone	Value £24	Cape Town Elec. goods	Value £117
Durban. Elec. goods	123	Sydney. Teleph. mat.	149
Hamburg. Elec. machinery	17	Vera Cruz. Elec. lamps	87
Total	£174	Total	£353

Football.—Glover's Cable Stranding Department, in winning the Broughton Rangers Inter-Works Competition Cup, may fairly be called the Rugby football champions of the Manchester workshops, as they have come out on top from among 108 competing teams. Among these were representatives of Mather & Platt, General Electric Co., Bertram Thomas, Frankenburg, Salford Corporation Meters Department, Lancaster & Tonge, Broughton Copper Works, Hetherington, and Reddaways & Co. Glover's scored in all 87 points to 3. The result was a foregone conclusion, however, as the notice put up in the works announcing early closing on the day of the match, stated quite definitely that the reason was to see Glover's win the Cup, which is now on exhibition at the works. The local interest taken in the event may be judged by the fact that over 6,000 people witnessed the final tie.

Directory.—We have received a copy of the thirty-third annual issue of the "City of London Directory," from the publishers, Messrs. W. H. and L. Collingridge, of Aldersgate Street, E.C. Those who want at hand a complete collection of information relating to the City, its Corporation and other public bodies, and a full directory of all persons who carry on trade or other calling in the City, will find this publication just the thing for them. A large coloured map of the City is one of its most useful features. The price is 12s. 6d.

Sale Notice.—The date of the sale of the Consolidated Telephone Co.'s factory at Coventry (see p. 737 of last issue) has been altered from May 22nd to Tuesday, May 26th.

Bankruptcy Proceedings.—The creditors of Harry South, electrical engineer, lately carrying on business at 10 and 12, Garrick Street, Covent Garden, met on May 1st, at the London Bankruptcy Court, before Mr. E. S. Grey, Official Receiver. It appeared that the debtor commenced business in 1884 or 1885 at John Street, Adelphi, with a capital of £200 borrowed from his mother. In 1889 he purchased the lease of 10 and 12, Garrick Street, where he traded in his own name until January, 1900, when the business was converted into Harry South & Co., Ltd., with a nominal capital of £10,000. Mr. M. J. E. Tilney subscribed £2,500, and became joint managing director with the debtor, who received as the consideration for the business £1,000 cash and £1,500 shares in the company. He was also entitled to £5 a week as salary, and a share of the profits. At the end of 1901 the company was ordered to be wound up, and Mr. H. H. Hilton was appointed as liquidator. The liquidation has not yet been closed, but 13s. 4d. in the £ has been paid to the creditors, who will eventually receive 20s. in the £. The certificate for the 1,500 shares is still in the possession of the debtor, who asserts that, in spite of a liability of £500 upon them, there will be some return. Since December, 1901, he has not done any business. The company took over all the assets, with the exception of the book debts and the lease of the Garrick Street premises. The lease, however, was sold under the liquidation, and there may be a few outstanding book debts to be collected. The liabilities of the business at the date of the transfer to the company have since been paid by the debtor. He has not yet filed the statement of his affairs, but roughly estimates his unsecured indebtedness at between £500 and £1,000, and he returns no free assets whatever. The failure is attributed to loss of business owing to differences with customers, and to competition, in consequence of which he was obliged to convert the business into a limited company; also to the failure of Harry South & Co., Ltd. The receiving order was made on April 16th, at the instance of creditors, and the public examination of the debtor is fixed for June 9th. Mr. W. B. Glasier attended the meeting on behalf of the petitioning creditors, and Mr. A. J. H. Smith for the debtor. Mr. Glasier moved a resolution for the appointment of Mr. R. J. Ward, chartered accountant, Clement's Inn, W.C., to the post of trustee. He said that, although the debtor professed to be devoid of assets, he held letters patent relating to some valuable inventions, and the creditors desired to have a thorough investigation into the case. Mr. Smith suggested that the matter ought to be left in the hands of the Official Receiver, because a considerable amount of animus had been imported into it by the petitioners. The debtor said it was utterly untrue to say that he now had any patent rights, as they had already expired. The resolution for Mr. R. J. Ward to act as trustee was declared to have been carried, and no committee of inspection was selected.

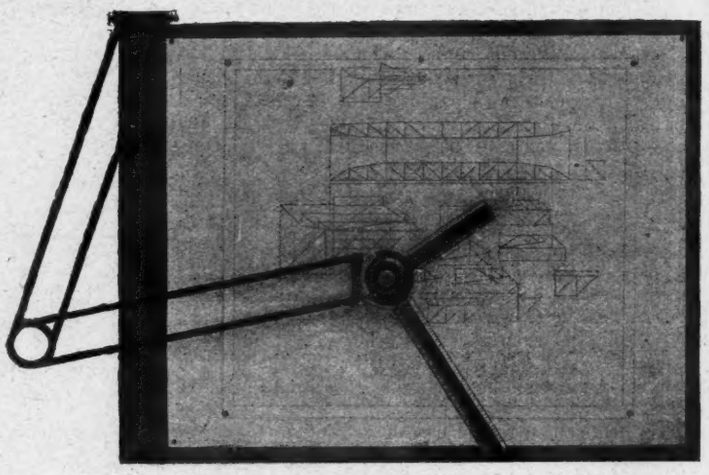
Liquidations. — Under the winding-up order made against the Telescriptor Syndicate, Ltd., meetings of creditors and contributories were held on April 28th, at Carey Street, before Mr. A. S. Cully, Assistant Official Receiver.

A meeting of the Electric Street Car Manufacturing Syndicate is to be held at Wolverhampton on June 6th, to hear an account of the winding-up from the liquidator, Mr. M. Fletcher.

Electricity versus Gas.—In view of the recent circulation of pamphlets by some of the Gas Companies proclaiming the overwhelming economy of gas for lighting purposes, it may be of interest to our readers to know how an installation at St. Peter's Church, Norbiton, has turned out. Alternating current is supplied by the Corporation at 105 volts, and costs 4½d. per unit; the Gas Companies' charges are 3s. per 1,000 cb. ft. The church is a fairly large one, having 152 8-c.p. lamps installed, and the work was carried out by Mr. John Biggs, of Borough Road, S.E., on the terms, and with the result, shown in the following letter sent by one of the churchwardens to the *Surrey Comet*:—"I beg to be allowed to correct the figures in the report of the St. Peter's Easter Vestry, as I fear they are not clear. The £45 paid Mr. Biggs yearly is by agreement, Mr. Biggs to pay out of this the gas and electric lighting accounts, and the balance to go to capital charge for the installation of the electric light. During the year ending March, 1903, we reduced this by £30 2s. 11d., the lighting costing only £14 17s. 1d. Our gas bill for the year ending March, 1900, was £36 17s. 8d., and for 1900 £37 1s. 8d. Thanking you in anticipation.—J. B. Walker." The church is, in the opinion of the congregation, far better lighted than it was, and the abolition of gas (which is only used in the vestry) has gone a long way towards curing the bad ventilation.

Fire.—With reference to the newspaper reports respecting last Saturday's fire at the Albion Clay Co.'s works at Albion, we learn that the fire was confined entirely to the company's electric light generating station, which is isolated from the main factory. No damage whatever was done to the works proper, so that operations are proceeding just as usual. No damage was done to the stock.

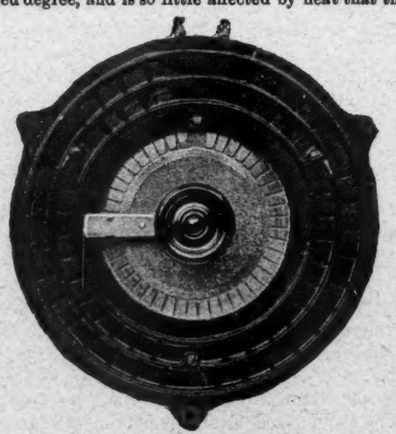
Universal Drafting Machine.—We have received from Messrs. Drake & Gorham, Ltd., of 66, Victoria Street, S.W., particulars of the "Universal Drafting Machine," a labour-saving device which they are selling in this country. Strangely enough, while other departments in an engineering establishment are overwhelmed with economic appliances, the drawing office has remained practically stationary. The universal drafting machine is designed to supersede the Tee square, set square, protractor and scale, being practically a combination of these elements, with the additional advantage that it is always on the board ready for use. The arrangement consists of a graduated square having an accurate parallel motion about the drawing board, the square being adapted



Universal Drafting Machine.

as most convenient for ordinary work. The blades of the square are interchangeable, and any length or scale can be supplied. The parallel motion is obtained by means of two pivoted parallelograms, which constitute a movable, flexible arm, joining the square to the board and controlling its movements, so that it always remains parallel to the position in which it was originally set. The device is interchangeable, and can be adjusted to any board. It will undoubtedly influence both the time taken and the accuracy attained in drawing office work.

Sturtevant Field Regulators.—The accompanying illustration shows the Sturtevant Engineering Co.'s ironclad granite-type dynamo-field regulator. This "C.H." type of apparatus consists of a base of insulating material, to which are attached the resistance wire, contacts and lever; the whole being carried by a japanned iron casing, which not only gives the instrument a handsome finish, but prevents the possibility of direct contact with the heat-radiating portion of the rheostat. No enamel or similar material is used in the construction, and the resistance material itself cannot possibly disintegrate through misuse. Grounding is impossible on account of the insulating base, and the compound by which the various current carrying parts are attached thereto is of such nature as to become practically part of the base when the apparatus itself is complete. This substance is claimed to possess the qualities of insulation, heat conduction and radiation to a marked degree, and is so little affected by heat that the makers



Sturtevant Field Regulator.

have frequently run the resistance wire to a white heat by passing excessive currents through it, without in any way causing the compound to deteriorate or separate itself from the base. This ensures the maximum factor of safety for the apparatus, as it makes certain that current will be carried without permanent damage up to the actual

burning-out point of the wire itself. The working parts of the apparatus are all amply proportioned for their designed load. With field rheostats for rear of switchboard mounting there is supplied a 5½-in. hand-wheel which is made throughout of copper, polished and lacquered. A hand-wheel of this kind possesses many advantages over the ordinary plated hand-wheel, the plating of which, in time rubs off and presents a bad appearance. The Sturtevant hand-wheels are of an entirely new design. Their insulation is of simple character, consisting of but a single large piece, and the Sturtevant Co. have consequently done away entirely with the loosening up of small parts, which sometimes happens with the insulated hand-wheel ordinarily supplied.

Catalogues and Lists.—Erith's A.B.C. brick dryer is the subject of a small pamphlet (No. 145) received from ERITH'S ENGINEERING Co. Another list from ERITH'S Co. describes the A.B.C. fan system of heating and ventilation for factories, machine shops, &c.

List No. 74 of the B.T.H. Co. gives prices of continuous and alternating current fan motors and exhaust fans; No. 144 explains the construction of their motor-control panels for continuous-current circuits.

A large and strongly-bound catalogue of "Helios" electrical machinery and apparatus has been sent to us by MESSRS. FRANK SUTER & Co., LTD., of 66, Berners Street, W. It consists of a collection of 22 different lists, in which are given many diagrammatic and general views, together with descriptive notes, and where possible prices, of arc lamps, overhead material for tramways, continuous and alternating current dynamos and motors, cut-outs, switchgear, transformers, controllers, field regulators, and numerous other special "Helios" lines.

A new set of illustrated lists has been sent to us by MESSRS. FOXCROFT & DUNCAN, of Queen's Road, Dalston. The various types of their electric measuring instruments, hatchet switches, Sappho and Phœnix arc lamps, &c., are well illustrated and described, and prices are given.

Automatic central station telephones for "reply and call" system form the subject of a list issued by the BERLINER TELEPHONE MANUFACTURING Co., of Queen Victoria Street, E.C.

Mr. J. A. WILLIAMS, of 92, Hatton Garden, E.C., has sent us a small pamphlet giving some particulars respecting magnalium, a metal whose electrical conductivity is said to be about half that of copper. Another list gives prices of sheets, rods, wire, tubes and castings of the new metal.

MESSRS. BERTRAMS, LTD, of Edinburgh, have placed before us a leaflet illustrating and particularising their "Midgett" two-cylinder air compressor for electric motor or belt drive. It claims to be specially suitable for dynamo cleaning, because of its simplicity, compactness and efficiency.

Trade Announcements.—Messrs. Morrison, Macduff and Co., 59, St. Vincent Street, Glasgow, have recently been appointed agents in Scotland for Messrs. Brecknell, Munro and Rogers, of Bristol, taking over the Scotch business as from April 1st.

Mr. A. E. Felgate has purchased the electrical engineering department of the business of the Speedwell Motor and Engineering Co., Ltd., at 10, Queen Victoria Street, Reading.

Messrs. Coles Bros. have started an electrical engineering business at High Street, Margate.

The Newcastle branch office of the British Thomson-Houston Co. has been removed from St. Nicholas Chambers, Amen Corner, to Collingwood Buildings, Collingwood Street, Newcastle-on-Tyne.

Mr. Archibald Campbell, Lonsdale Chambers, 27, Chancery Lane, W.C., has been appointed agent for London and South Coast for Messrs. W. J. Garnett & Co., of Bradford, who are now manufacturing cables, flexibles, &c. Mr. Campbell is keeping fairly large stocks so that deliveries can be promptly made.

We are informed that Messrs. Francis & Co., of 20, Bucklersbury, E.C., are not now acting as Mr. A. P. Lundberg's agents, and all orders should be sent direct to Pioneer Electrical Works, Liverpool Road, N.

The business of Fenner, James & Co., makers of accumulators, &c., has been acquired by Fenner, James & Co., Ltd., and the works have been removed from 78, York Road, King's Cross, N., to more commodious premises, at 23, Berwick Street, Oxford Street, W.

Messrs. Easton & Co., Ltd., have appointed Messrs. J. Lomax, Kendal & Co., of St. James's Square, Manchester, as agents for their electrical and hydraulic lifts for the cities of Manchester, Stockport and Salford, and all communications relating to lifts should be addressed to them. This notice relates to lift business only.

Annual Picnic.—The employés of Messrs. George Hill and Co., of Manchester, held their annual picnic on Saturday, May 2nd. Part of the morning was spent on the river at Chester, and a stop was made at the Iron Bridge for lunch. On returning later to Chester, dinner was served and a concert followed.

Belgium.—The Bell Telephone Manufacturing Co., of Antwerp, reports a profit of £7,020 for the last financial year.

A Pacific Power Scheme.—The Stone & Webster electrical management, of Boston, U.S.A., now operating a score of companies in North American territory, has awarded to the General Electric Co., of Schenectady, a considerable contract for generators, to supply power for the tramways, lights and factories of a group of cities on the northern Pacific coast, near Puget Sound, in the State of Washington. The order includes six 3,500-KW. generator sets to be direct connected with tangential water-wheels operated by glacial flow, taken from the Puyallup and White Rivers. The torrents have their rise on Mount Rainier, a volcanic peak rising to a height of 14,500 ft. Here are 16 glaciers, covering an area of 100 square miles, with a thickness varying from 100 to 1,500 ft. approximately, which serve as unfailing reservoirs. The machines, which will be completely installed during the coming autumn, will develop a total of 30,000 H.P., part of which will be employed by the Stone-Webster concern for its traction and lighting business—including its "inter-urban" electric line between Seattle and Tacoma—before the end of the year. When the glacial flow is fully utilised, it is believed that it will be feasible to transmit the electric power developed from it southward to Portland, in Oregon, and northward to Victoria, in British Columbia.

For Sale.—The Wolverhampton electricity department wants offers for the purchase of arc lamps and fittings. Some details are given in our advertisement pages to-day.

ELECTRIC LIGHT AND POWER NOTES.

Arbroath.—The T.C. has had under consideration the terms of the National Electric Wiring Co., London, but has decided to postpone any definite decision until a report is received on the subject from Mr. Hogarth, the Council's engineer.

Barnstaple.—As an outcome of the action brought against the T.C. by Mr. Chanter, who sought to obtain an injunction restraining the Corporation, as owners of the electricity works, from wiring premises and dealing in electric light fittings, the Corporation has accepted an offer from Messrs. Alger & Sons to carry out the wiring of consumers' premises, and has disposed of the stock to that firm at invoice price. The case against the Corporation is referred to fully in our other columns.

Blackburn.—During the past year the receipts of the electricity undertaking amounted to £25,750 7s. 10d., and the working expenditure to £14,208 3s. 7d., leaving a gross profit of £11,342 4s. 3d. Interest and sinking fund absorbed £9,707 19s. 1d., leaving a net profit of £1,834 5s. 2d., which was applied to the liquidation of last year's deficiency of £2,492, reducing it to £657. 2,503,639 units have been sold at an average price of 3·83d. The average price for power purposes was 1·59d., and for tramway traction 1·5d. per unit. The total costs have been reduced from 1·48d. to 1·20d. per unit. The capacity of the works is now 3,720 H.P., and the maximum load during the year was 1,638 KW.

Bo'ness.—At a mass meeting of ratepayers, a resolution was adopted unanimously that the adoption of the agreement with the National Electric Wiring Co., relative to lighting the town with electricity, be delayed, with a view to obtaining better terms.

Bristol.—The result of the past year's work shows that the use of electricity for power purposes has continued to increase. The sale of energy for this purpose during 1902-3 has more than doubled, the units sold being 688,740 as against 310,054. The gross profits were £27,165 9s. 7d., and after meeting financial charges a net profit of £5,872 6s. remained, which was appropriated as follows:—Reserve fund, £1,490 17s. 6d.; depreciation and contingency account, £4,368 4s. 11d.—balance, £13 3s. 7d., carried forward.

Chesterfield.—The results of the first year's working of the Corporation electricity undertaking show a gross profit of £2,501 12s., and after meeting financial charges, there is a net profit of £851 8s. 1d.

Derby.—The Lighting Committee reports a profit on the year of £597 5s. 11d. There was a balance brought forward of £1,102 9s. 2d.; the generation of electricity cost £5,501 17s. 11d., distribution £956 12s. 7d., public lamps, £579 1s., and general expenses £1,795 18s. 8d., making a total of £9,935 19s. 4d. The receipts were:—Energy by meter, £14,975 16s. 3d., public lighting, £2,738 4s. 11d, rents of meters and motors, £809 8s. 6d., sundries £506 9s. 7d., balance carried forward, £978 16s. 7d., making a total of £20,008 15s. 10d. After deducting expenses there is a profit on the revenue account of £10,072 16s. 6d., and after providing for financial charges there remains a balance to be carried forward of £597 5s. 11d.

In connection with the report just presented to the E.L. Committee on the proposed change of system of electric supply, which it is contemplated to gradually carry out as new plant is required, the Committee has also considered the question of extensions to cope with the increase of business, including generating plant for the proposed electric tramway, and has approved of the expenditure of £8,300 on the lighting department, including £1,300 for a boiler, superheater and purifier, £1,300 for overhead coal bunkers and plant, £2,500 for one 300-KW. turbine and dynamo, £500 for ejector condenser, &c. For traction it is estimated that £10,100 will be required for additional boiler, &c. (£1,300), two 300-KW. turbines and dynamos (£5,000), two condenser plants (£1,000), switchboard (£600), reversible boosters (£500), &c. For the outdoor requirement of the lighting department it is estimated that £9,300 is required for mains and plant. The total amount the Committee has decided to ask the Council for is £33,400, but in order to save delay it has invited tenders for the boiler, &c., elevator, &c., and, subject to the approval of the Council, has accepted the tenders of Messrs. Babcock & Wilcox (£1,240) for boiler, with superheater, purifier and chain grate stoker, and that of Messrs. G. Fletcher & Co. (£1,074) for coal elevator, carriers and

bunkers. The Committee is preparing plans for the erection of a new station on the site adjacent to the present one which, with the first instalment of machinery, is estimated to cost £5,000.

Dorking.—In response to the U.D.C.'s objection, the B. of T. has eliminated Dorking from the area of supply under the Leatherhead and District E.L. prov. order.

Dublin.—In an action before Mr. Justice Madden and a jury, James Timmons sued the British Insulated Wire Co. to recover £2,000 damages for personal injuries sustained through the company's alleged negligence. The parties eventually came to terms, the defendant company paying £125 damages and £100 costs.

Halifax.—The L.G.B. has informed the T.C. that it will sanction a loan of £23,950 for E.L. purposes. It has excluded £2,700 relative to the debt on the 300-KW. alternator set, which sum may be taken from the renewal fund.

Hanley.—The T.C. on April 28th decided to apply to the L.G.B. for a loan of £5,000 for the provision of additional generating plant. The advisability of adopting penny-in-the-slot meters, and also of substituting steam turbines at the electricity works for two of the Brush engines, is under consideration.

Hayfield.—The R.D.C. has withdrawn its opposition to the North-Western Electricity Bill, the promoters having granted the necessary concessions.

London.—CAMBERWELL.—The Borough Council having applied to the County of London and Brush Provincial Electric Lighting Co., Ltd., and to the Board of Trade for a return of the expenditure incurred by the company under the Camberwell Electric Lighting Order, 1896, has published a statement from which it appears that the total expenditure up to December 31st, 1902, was £165,466 1s., made up as follows:—Lands (leasehold and freehold), including law costs incidental to acquisition, £11,130 15s. 3d.; machinery (erected at the company's Wandsworth station) £21,361 17s. 9d; mains, including cost of laying, £112,106 4s. 7d; transformers, motors, &c., £15,446 14s. 10d.; meters and fees for certifying under the Act £3,747 18s. 7d.; switchboards and electrical instruments £661 13s. 6d.; cost of provisional order £944 12s. 8d.; office furniture and fixtures at station £26 3s. 10d.; special items £40.

ISLINGTON.—The Lighting Committee has received an application from the contractors to the Great Northern and City Railway for a supply of electricity for motive power to be taken continuously day and night from the beginning to the end of the working week. The following motion was adopted: "That in all cases where consumers have a load factor of not less than 50 per cent. for a six monthly period comprising two consecutive summer and winter quarters, the rate charged as from April 1st, 1903, be the daylight rate, viz., 2d. per unit, and that in such cases the higher rate be eliminated."

STEPNEY.—A motion was adopted at the B.C. meeting that electric light mains be laid and arc lamps erected in Watney Street at an estimated cost of—mains £950, lamps £420.

GREENWICH.—The B.C. intends to continue negotiations with the Blackheath and Greenwich Electric Lighting Co. with respect to the company's Bill in Parliament. It was resolved that should the company's proposals not be sufficient to protect the interests of the Borough, counsel should be briefed to oppose the Bill.

BATTERSEA.—The B.C. has resolved to light the roads on the Latchmere Estate with arc lamps. An offer from Messrs. Belliss and Morcom, Ltd., to purchase one of the generating sets (engine and dynamo) removed from the Town Hall electric lighting station, for £220 10s. has been accepted. The Council has sealed an agreement with the County of London and Brush Provincial Electric Lighting Co., Ltd., as to the transfer of three areas to make the boundaries co-terminous as suggested by the Board of Trade at a recent conference.

BERMONDSEY.—At the meeting of the B.C. the E.L. Committee brought up a long report by Mr. W. H. Vincent, M.I.E.E., on the proposed extensions to the electricity undertaking. He recommended that two 300-KW. sets be installed, which would allow a further connection of 40,000 8-C.P. lamps. In Rotherhithe, where a supply had not yet been given, he had no hesitation in saying a very satisfactory demand would arise, chiefly for motive power for small manufacturers. He proposed for this district the high-pressure continuous current system, with transformer sub-stations. The 300-KW. generators, with a voltage of 2,000, would transmit energy to the sub-stations, where it would be transformed to low pressure through motor-generators arranged to feed the existing distributing network. One sub-station would be built at first, to accommodate four 150-KW. transformers (which would be capable of dealing with 20,000 8-C.P. lamps), a battery, battery-charging booster, and balancer. Two transformers would be installed at first. To avoid increasing the low-pressure sets at the generating station to meet the increasing demand in Bermondsey, he proposed that the two 300-KW. high-pressure sets should be common to the supply in either area. To do this the current would be transformed in the generating station, and fed on to the bus bars of the existing switchboard. The estimated expenditure on the extensions was:—Destructors (including tipping platform), £3,200; boilers, £2,560; superheaters, £320; mechanical stokers, £608; conveyor, £1,450; piping, valves, pump, &c., £1,370; steam generators, £6,560; switchboard, £750; transformers, £1,630; transformers (for sub-station), £1,630; booster, £450; balancer, £270; battery, £1,823; switchboards (for sub-station), £800; wiring generating works and sub-station, £400; mains, £7,615; generating works building, £12,900; sub-station building, £3,000; 35 arc lamps complete, £968; mains, switch pillars, &c., £793; contingencies, £2,455; total, £51,552. After a short discussion, the consideration of the matter was adjourned to the next meeting.

The Housing Committee of the Bermondsey Borough Council reported on Tuesday that it had considered a suggestion from the Electric Lighting Committee that the electric light be installed in the working men's dwellings erected by the Council in Rotherhithe. A letter had also been received from the South Metropolitan Gas Co. offering to lay the necessary gas pipes and fittings and put in penny-in-the-slot meters free of expense, provided the electric light was not installed in the buildings. The Committee recommended that the company's offer be accepted on the score of cheapness.

Malton.—The U.D.C. has adopted a recommendation that the B. of T. should be asked to revoke the order granted to the Northern Counties Electricity Co. in consequence of their failure to light the town.

Malvern.—At the L.G.B. inquiry on April 30th into the application of the U.D.C. for loans of £18,200 for electric lighting purposes, there was no opposition. The scheme will provide for 5,000 lights, and £3,000 is needed for a refuse destructor, to be worked in conjunction with the electric light works.

Port Glasgow.—The shipyard of Messrs. Wm. Hamilton and Co., Port Glasgow, has been equipped with electric plant for power and lighting purposes on a very extensive scale.

St. Annes-on-the-Sea.—The results of last year's working of the electricity undertaking show that the increase in units sold over the previous year is 58½ per cent., the year's output being 155,555 B.T.U. Lamp connections have increased 76 per cent., and the cost of production has fallen from 2·37d. per unit to 1·88d.

Salford.—The Electricity Committee of the T.C. has fixed the price of electricity for power purposes after July 1st next, at 2d. per unit up to 7,000 units, 1½d. for the next 10,000, and 1d. per unit beyond.

Sleaford.—The L.G.B. has held an inquiry into the application of the U.D.C. for a loan of £2,000 for additional engines and dynamos. There was no opposition.

Scottish Central Electrical Power Bill.—The County Council of Stirling intends to oppose this Bill, and the Law and Parliamentary Committee has been instructed to endeavour to secure the co-operation of the counties of Linlithgow and Clackmannan, and any burghs which might desire to be associated in the opposition. The Council does not oppose the Bill as a whole, but protests against certain clauses thereof. On the same date a joint meeting of the Falkirk T.C. and the Falkirk and Larbert Water Trust was held, and agreed to present separate petitions against the order.

Shipley.—The L.G.B. has given its sanction for the borrowing of £46,250 for E.L. purposes.

The Trademen's Association has asked the Council to largely extend the E.L. scheme.

Stafford.—The T.C. has decided to extend the mains at a cost of £500, and when the powers to supply outside the borough are obtained, to carry out further extensions at an outlay of £688. A loan of £3,200 is to be applied for to cover the cost. In the course of the discussion it was pointed out that the undertaking costs the ratepayers a 4d. rate, and that further expenditure ought not to be incurred without some guarantee as to a profitable result.

Stroud.—The B. of T. has granted a prov. order for electric lighting to the U.D.C.

Wellington (Salop).—Replying to the Corporation's request for an extension of time in which to carry out the electric light scheme, the Board of Trade states that it will consider the matter on learning what steps are being taken to carry out the work, on July 26th, the date of the expiration of the order.

Whitehaven.—The Board of Guardians has asked the T.C. to quote for a supply of electricity for lighting the workhouse and the infirmary.

ELECTRIC TRACTION NOTES.

Belfast.—At the monthly meeting on the 1st inst. the Corporation passed the draft agreement for the purchase of the Belfast Street Tramways. If acceptable to the company, it would provide for the transference of the Belfast and also the Sigoneri and Sydenham lines to the Corporation as from August 10th. The proposed terms briefly are, such a sum as would be paid on August 10th, 1907 (when the lease expires) plus the net estimated profits of the company's undertakings for three years, and compensation to the directors, manager and secretary. Failing a mutual agreement as to the purchase money, then it would be fixed by the arbitration of a Government official. The Lord Mayor stated that Mr. Wyndham, the Irish Chief Secretary, said that there would be no difficulty in passing a Bill on these lines through the House of Commons. The Bill, of course, would also provide for the electrifying of the system.

Birkenhead.—The Tramways Committee has decided upon an enterprising step with a view to utilising double-decked cars on the Birkenhead and New Ferry route. At one point the line has passed under a railway bridge, the height of which from the track rails has not admitted of the use of double-decked cars. The Committee has decided to spend £1,000 on altering the level of the street (Chester Street) under the railway. The Committee calculates that with large, double-decked cars on the route the receipts would be increased by 1d. per mile, which would represent an increased revenue for the year of £1,320.

Blackburn.—Mr. A. S. Giles, electrical engineer and tramways manager, has presented to the Tramways Committee his annual report upon the past year's working. The receipts amounted to £42,179, and the working expenses to £25,702, leaving a gross profit of £16,476. Interest and sinking fund absorbed £20,551, leaving a deficit of £4,074 18s. 1d., as against a loss of £6,691 13s. 9d. in the previous year. The following table shows the progress made during the past three years, ending March 25th:—

Year.	Mileage.	Passengers.	Receipts.	Average per mile.
1901 ..	637,266	6,759,511	£31,329 14s. 5d.	11·79d.
1902 ..	738,557	6,790,091	£36,168 15s. 5d.	11·74d.
1903 ..	826,558	7,231,106	£40,963 18s. 4d.	11·89d.

In dealing with the financial aspect of the tramways undertaking, Mr. Giles says the capital expenditure at the beginning of the year was £275,651, of which £96,577 represented the goodwill of the late tramway company. Thirty years are allowed for the repayment of the purchase money, and last year's payment of interest and redemption totalled £5,984. The cost of reconstruction of the old horse and steam-haulage system to electric traction (for which 20 years is allowed for repayment) involved a payment last year of £6,418 interest, and £8,149 sinking fund. "It will be seen that the tramway undertaking is burdened with the heaviest charges at a period when its business is just commencing to develop, but there are indications of an increased revenue. In a few years we may expect to meet expenditure and have a balance, which should be devoted to reserve for renewal of track, which will become necessary before the expiration of the loan period." The report then goes into details, showing that £5,691 has been added to revenue at a less working cost than last year. The year's loss, it is pointed out, arises from the small use made of the tramway service in comparison with its earning power, and the heavy capital charges arising from the purchase of the old company's undertaking.

Buenos Ayres.—Consul Ross in his report on the trade of the consular district of Buenos Ayres for the year 1902, states that the application of automobiles in his district is increasing, and a demand, he thinks, will arise, especially for electric cars in the town and other kinds outside. The conversion of the tramway traction from horses to electricity, he states, goes on very slowly, but it is being gradually effected. The importance of this movement is shown in the following table, which gives the mileage of each system existing at the end of 1902, and the number of passengers carried during the year:—

	Horse traction.	Elec. traction.
Length of line	216 miles	68 miles
Passengers	81,640,000	33,802,000
Receipts	£1,100,000	£1,072,500

Burnley.—At the meeting of the Corporation Tramways Committee on April 29th it was reported that the gross profit on the year's working of the tramways was £11,480, and the net profit £2,579.

The Corporation Tramways Committee has asked the Electricity Committee to reduce the charge for current supplied to the tramways from 1¾d. per unit to 1½d.

Bury (Lancs.).—The B. of T. has granted a prov. order authorising the T.C. to extend the electric tramways in the town.

Cheltenham.—The T.C. has applied to the L.G.B. for a loan of £21,028 for the paving of the tramway route with Jarrah wood blocks.

Crewe.—By 12 votes to 6 the Corporation Light Railways Committee on April 30th decided to support the scheme of a Manchester syndicate for the provision of electric tramways for the town, on condition that the interests of the town are properly safeguarded, and satisfactory purchase clauses are inserted.

Derby.—The Tramways Committee has decided to recommend the Council to accept the overhead trolley system, and to proceed at once with the construction of tramways on several routes which will not be affected by the main drainage scheme now being carried out. The Committee estimate that the construction of the permanent way on the routes in question will cost £55,915, that the electrical equipment of the same will necessitate an expenditure of £10,150, that car-sheds and buildings will cost £7,000, and that 25 cars will cost £12,500, and they are applying to the Council for £85,565 for the work in question. They further consider that the overhead trolley system is the most economical system, and that it is generally suitable for the requirements of Derby.

Dudley.—A Sub-Committee of the Corporation has been appointed to open negotiations for the purchase of the electric tramways in the borough.

Gloucestershire.—General satisfaction is felt amongst the manufacturers of the Stroud Valley at the successful passage of the local tramway Bill through the Committee of the House of Commons, as the adoption of electric traction will undoubtedly lead to the development of the district. The difficulties between the Corporation of Gloucester and the county authority have also been settled, and a scheme has been agreed upon for the laying down of electric tramways in the city as soon as possible.

An agreement has been arrived at between the Corporation and the County Council relative to the construction of the electric tramway from the city boundary to Hucclecote. This line is to be leased to the Corporation for 99 years, at a yearly rent of £50, the Corporation to pay the instalments of loan and interest on the sum actually payable by the County Council for the first 40 years.

Lancaster.—The first quarter's traffic on the tramways was satisfactory. The Scotforth route has been in working order for the whole of the time, but the Park route was only definitely sanctioned by the Board of Trade at Easter. With a population of 41,000, and the trams only tapping three districts, 272,649 passengers were carried in the three months. The total receipts were £994, and the expenditure (exclusive of interest and redemption), £858. The cost per car-mile was 6·1d. A third route is to be immediately proceeded with, taking the cars past the Castle station of the L & N.W. Railway and down to the athletic grounds.

London "Underground."—The Metropolitan District Railway Co. expect to open a section of their line, six miles in length, between South Harrow and Ealing, for electrical working in the course of a few weeks. The working of the main line by electric traction depends upon the date of the completion of the power house at Lot's Road, Chelsea, which is being pressed forward with the greatest possible speed.

Manchester.—It was announced at a social gathering, held the other evening to celebrate the completion of the Manchester tramway system, that the last of the difficulties in the way of a working arrangement with Salford had been removed. In a review of the work of his department, Mr. Boyle, the chairman of the Tramways Committee, stated that since the work was taken in hand by the Corporation over 30,000 tons of steel rails had been laid down in the streets. There were 106 junctions in the city, necessitating special track work, which was done at the cost of £75,000. In this connection, he said, it was interesting to note that when the Committee advertised for tenders only one firm offered to do the work, and that an American one. Now, when there was no great demand for special junction rail work, some Sheffield firms were in a position to undertake it. There were employed (Mr. Boyle added) in the traffic and car-shed section of the department 2,419 men, and on the permanent way 1,212, in addition to 227 clerks and storekeepers, of whom 112 were women. The capital expenditure up to the end of the present financial year would reach a million and a half, for which the citizens were getting a good return. The Committee hoped in future years to increase the grant—amounting to £50,000 for the past year—towards the relief of the city rates. It was also the Committee's intention to establish a thrift fund for the benefit of the large number of wage-earners in their employment.

Public attention is being called to the question of an underground electric railway, which will relieve the congestion of traffic in the central parts of the city. The promoters have approached the Corporation on the subject, and are hopeful that the scheme will be allowed to proceed without municipal opposition. The Corporation now own all the tramways within their jurisdiction, and they may regard very seriously any scheme that will enter into competition with them. The matter is at present under the consideration of the Tramways Committee.

Mersey Railway Electrification.—On Monday, May 4th, the Mersey Tunnel Railway entered on a new era of its history, an electrically worked service of trains being opened to the public on that day. Since February 1st, 1886, the railway through the Mersey Tunnel has been worked by steam, and for a time the service enjoyed a moderate amount of public patronage. Until quite recently the service has been confined to passenger traffic, but about three years ago the carriage of parcels and light goods was commenced. Latterly the line lost support from the public, partly owing to the competition of the ferry steamers, but mainly owing to the unpleasant and unfavourable conditions of working. Stations, tunnel and carriages were smoky, chilling and depressing. Different schemes of improving the service were considered, and in July, 1901, a contract was entered into between the British Westinghouse Electric and Manufacturing Co. and the Mersey Railway Co., under which the Westinghouse Co. undertook to equip the line electrically, the work to be carried out within 18 months. The price agreed upon was £635,303, to be payable in £620,000 4 per cent. Mersey Railway new first perpetual debenture stock, and £15,303 in cash.

There are seven stations on the system, three of them only being surface stations. The main tunnel is 26 ft. in extreme width and 19 ft. high from the track-rail head to the crown of the arch. The track has been relaid with rails weighing 86 lbs. per yard in 36-ft. lengths, placed on cross sleepers. Insulated lead and return conductors on the third and fourth rail system have been laid, the positive rail being on the outside of the track, and the negative rail being in the centre of the track rails. Earthenware insulators in the form of hollow cubes support the conductor rails. Flexible bonds of the "Protected" type are used with the rails, each joint having two web bonds of 400,000 circular mils. The conductors are of the "T" type, and are of two weights, 100 lbs. and 60 lbs. per yard.

A new generating station was erected at Shore Road, Birkenhead. It contains three main units, each consisting of a vertical cross-compound steam engine of approximately 1,650 H.P., direct-coupled to a generator, yielding direct or alternating current, or both, of Westinghouse double-current pattern. The engine cylinders are 30 in. and 60 in. in diameter, with a stroke of 48 in.

Each generator is of 1,250 KW., and will supply direct current at a pressure of 650 volts, or three-phase alternate current with a frequency of 25 periods per second when running at 94 revolutions per minute. The generators have fields with 32 poles each. The fields are compound-wound, the pole pieces being of soft steel stampings. The armatures are of the slotted core, drum-wound type. Two smaller generating sets have also been provided. These consist of a Westinghouse compound engine, direct-coupled to a 200-KW. generator of multipolar type, which will yield direct current at a pressure of 650 volts, at 250 revolutions per minute. A storage battery of 320 Chloride cells, and a motor-driven boosting set are also provided. The main switchboard is of Westinghouse type, and comprises 19 main panels. The feeders pass from the station to the line, the cables being of B.I.W. lead-covered paper-insulated type. Steam power is supplied by nine Stirling water-tube boilers, each having a heating surface of 4,370 sq. ft. A normal pressure of 170 lbs. will be maintained. The boilers are provided with Roney mechanical stokers. Clay Cross economisers are used, and also a Harris water softening plant. The Holly gravity return-pipe system has been adopted, by means of which condensed water returns automatically to the boilers.

The present rolling stock consists of 24 motor-cars and 33 trailers, 12 of the motor-cars being first-class, and 12 third-class. The first-class cars will accommodate 48 passengers, and the third-class 50. Of the trailer cars, the first-class, of which there are 11, will accommodate 60 passengers each, and the third-class, of which there are 17, 64 passengers each. There are five composite cars, accommodating 22 first-class and 40 third-class passengers. All of the cars are built on the corridor principle. The bodies have been supplied by Messrs. G. F. Milnes & Co., Hadley. The trucks were manufactured by the Baldwin Locomotive Works Co., Philadelphia. Each motor-car is provided with four Westinghouse No. 83 type motors, of 100 approximate H.P., working at from 550 to 600 volts, of the enclosed four-pole type.

On Sunday morning last a party consisting of representatives of the Mersey Railway Co. and of the Westinghouse Co. and of the Press travelled from Liverpool over the newly electrified railway and visited the generating station at Shore Road. The party returned to the Adelphi Hotel, Liverpool, where a luncheon was served. After the luncheon, speeches bearing on the electrification of the Mersey Tunnel Railway and the prospects of the improved service were delivered by the Lord Mayor of Liverpool (Mr. W. W. Rutherford, M.P.) and the Mayor of Birkenhead (Dr. O. Morris) and others. In the course of his remarks, the Mayor of Birkenhead spoke in complimentary terms of the way in which the electrification of the railway had been effected by the Westinghouse Co. without interfering with the daily traffic of the railway while worked by steam.

The first-class cars have polished mahogany panels inside, and padded cane seats. The third-class cars are finished in light oak, with bent-wood seats. Outside, the cars are finished in a rich, dark red, which is relieved with gold lines. The motorman's apartment has been made fireproof by means of a lining of asbestos slate.

With regard to daily service, a three minutes' service has been arranged between the Central Station, Liverpool, and Hamilton Square station, Birkenhead, and a six minutes' service from the Central Station, Liverpool, to the Park and Rock Ferry stations. This represents a considerable acceleration of the recent service. The traffic arrangements have been carried out by Mr. R. Bowman Smith, traffic manager of the railway. Mr. J. Shaw is the resident engineer.

The first electric train was run over the electrified track on January 31st. Since that date, almost continuous experimental runnings have been maintained between the ordinary steam service and during the night.

Newcastle-on-Tyne.—At a meeting of the Tramways Committee on the 30th ult., the city engineer reported that he had arranged with the Elswick Colliery Co. for heightening the bridge on Scotswood Road. This will allow double-deck cars to proceed along that thoroughfare. Mr. Le Rossignol presented a report as to the cost of producing energy, which showed that it was about the lowest in the country.

Oldbury.—The electrification of the tramways has been postponed for a further period of 12 months.

Spen Valley.—The B. of T. has extended the time for completing the whole of the tramways authorised by the Spen Valley Order of 1901 for six months from April 22nd.

Railway Statistics.—In the May number of the *Railway Magazine* Mr. J. Holt Schooling shows that in 1901 the length of the railway line open for traffic—22,078 miles—was nearly three and a half times as great as in 1850, while the number of passengers carried has increased more than sixteenfold, from 73,000,000 to 1,172,000,000. As to the value of the lines, in 1850 the paid-up capital was 240 millions, and the National Debt was 551 millions more; in 1901 the paid-up capital of the railways was 1,196 millions, and the National Debt stood at 706 millions, or 490 millions less. In 1895 a valuation of the whole wealth of the United Kingdom placed the capitalised value of land, homes, furniture, rails, cattle, factories, implements, merchandise, shipping, bullion, &c., at 11,806 millions sterling. It follows that the railway capital is over 10 per cent of the whole value of the country.

Ramsbottom.—The U.D.C. has decided itself to carry out the electric tramways order just granted by the B. of T. in conjunction with the E.L. order. A combined scheme has been prepared by Mr. A. B. Chatwood, consulting engineer, of Bolton. The proposed tramway will be 5½ miles long, and will run from Holcombe Brook to Edenfield, and from the latter place *vid* Shuttle-with to the Market Place.

Rhondda.—The U.D.C. is negotiating with the B.E.T. Co. with a view to the leasing of the electric tramway Order recently obtained.

Prestatyn.—The U.D.C. has decided to oppose the application of the Rhyl and Prestatyn Electric Tramway Co. for an extension of time from April 1st, 1903, to April 1st, 1905, in which to complete the undertaking.

Sunderland.—At a meeting of the Tramways Committee on the 30th ult., it was decided to give a trial to the Thermit system of welding tramway rails, under which it is believed that a considerable economy will be effected, as it will prevent the hammering of the joints. Mr. Snell, the electrical engineer, reported that the equipment and alteration of Tatham Street corner, erection of the car-sheds, &c., had cost £13,844, as against an estimated cost of £17,174. This latter figure included £800 for the doubling of the line at the Londonderry Hotel corner, which was yet to be done, so that there was a saving on the estimate of not less than about £2,500. This is due to the fact that there were no gas or water mains, nor any expenses for contingencies, to be met.

Wolverhampton.—A meeting of the Town Council in Committee—but to which the press and the public were admitted—was held on Monday for the purpose of considering Mr. C. E. C. Shawfield's report on the working of the Lorain system of electric surface contact, and also a report from the Tramways Committee on the same question. Mr. Shawfield's report has been already abstracted in the columns of the ELECTRICAL REVIEW. By 5 votes to 3 the Committee recommended:—

That the Corporation shall take over and accept the 11·375 miles of single track from the Lorain Steel Co., as from April 17th, 1902, and that payment be made to that company for the electrical equipment thereof, in pursuance of the terms of the contract with the company, dated July 17th, 1901, subject to the contractors undertaking to replace, free of cost to the Corporation, all the existing top plates and granite casings with others of a type approved by the borough engineer and electrical engineer, as and when such renewals and replacements become necessary, and subject to their executing and supplying free of cost as aforesaid, such further work and materials as may be necessary to comply with their obligations under Clauses 37 and 38 of the contract, and that in default of this being done all matters in dispute be referred to arbitration.

The Committee therefore submitted the motion for adoption by the Council, and expressed a desire to place on record its high appreciation of the services rendered by Mr. Shawfield, the electrical engineer, in his supervision of the Lorain system. This was the condition of affairs when the Council met on Monday, and as an evidence of the great interest taken in the matter, it should be stated that there was a numerous attendance of the general public. Alderman C. T. Mander, chairman of the Tramways Committee, had returned from the Continent specially for the meeting, and he proposed the resolution which had been carried in committee as above, with this alteration, that after the first three words, "That the Corporation," there was placed this important addition—"notwithstanding the non-compliance by the company with the conditions of the contract dated July 17th, 1901," shall take over, &c. Alderman Mander at some length endeavoured to discredit the calculations of the electrical engineer in his report; but, unlike Mr. Mander's attitude in 1901, he held out no promises of profits if the Lorain system of traction were adopted. In fact, he frankly admitted that the Council must not look to the Tramways Committee for anything in relief of the rates for some years to come. Alderman Craddock, deputy chairman of the Committee, seconded the resolution, and foreshadowed gross profits amounting to as much as £31,000 when all the lines are in operation. The alderman, however, admitted that he had a tendency to exaggeration. Councillor White submitted the following amendment:—

That the Council being of opinion that the 11·375 miles of single-track installed by the Lorain Steel Co. does not fulfil the conditions imposed on the said company by the contract between them and the Corporation, the Council declines to take over and pay for the same, and calls upon the company to carry out the stipulations contained in Clause 16 of the said contract, or to proceed to arbitration under Clause 18 of the same contract.

This was seconded by Councillor Bantock, and supported by Councillor Crosbie. All three condemned the Lorain system as a failure, and predicted that its adoption would ultimately increase the rates of the borough. Councillor Bantock submitted to the Council a long list of manufacturers in the borough who had declared themselves opposed to the system. At the conclusion of Councillor Crosbie's speech, the debate was adjourned for a week.

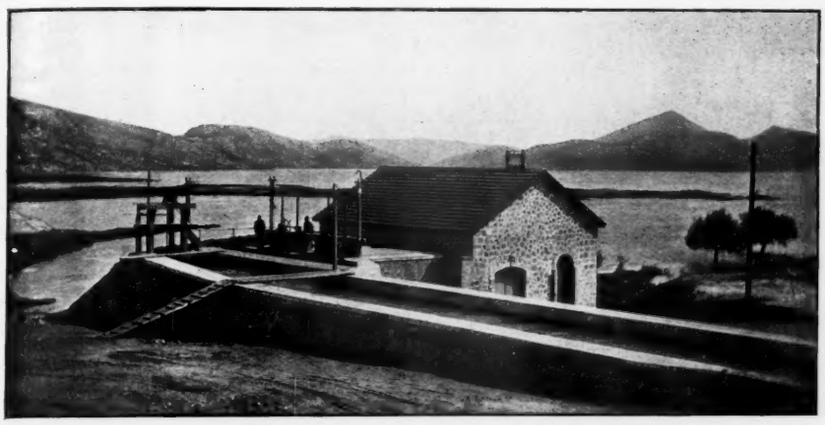
TELEGRAPH AND TELEPHONE NOTES.

Telegraphists for the Transvaal.—On Saturday morning last, May 2nd, there assembled at Waterloo Station a large number of friends, and over 100 students of the South London Telegraph Training College, Brixton, to bid farewell to 12 of their fellow students who sailed later in the day from Southampton in the *Tintagel Castle* for South Africa. These young men have received lucrative appointments in the Central South African Government Railways as expert telegraphists, and proceed direct to Pretoria. From thence they will be sent to various stations in the Transvaal and Orange River Colony. Later in the day two wireless operators, trained at the same college, left for the new Marconi wireless telegraph station, near Liverpool.

(*Continued on page* 789.)

POWER TRANSMISSION IN GREECE.

An interesting scheme for the utilisation of water power and the transmission of energy has recently been completed in Greece. It is probably unique as being the only electrical scheme which derives its power from water in that country, where the majority of the rivers are quite dried up during the summer months.



View of Power House and Head Race.

It can also claim to be the first example of three-phase work in Greece, for although a large polyphase station has recently been erected at Phalerum, in the neighbourhood of Athens, it has not yet commenced supplying outside customers.*

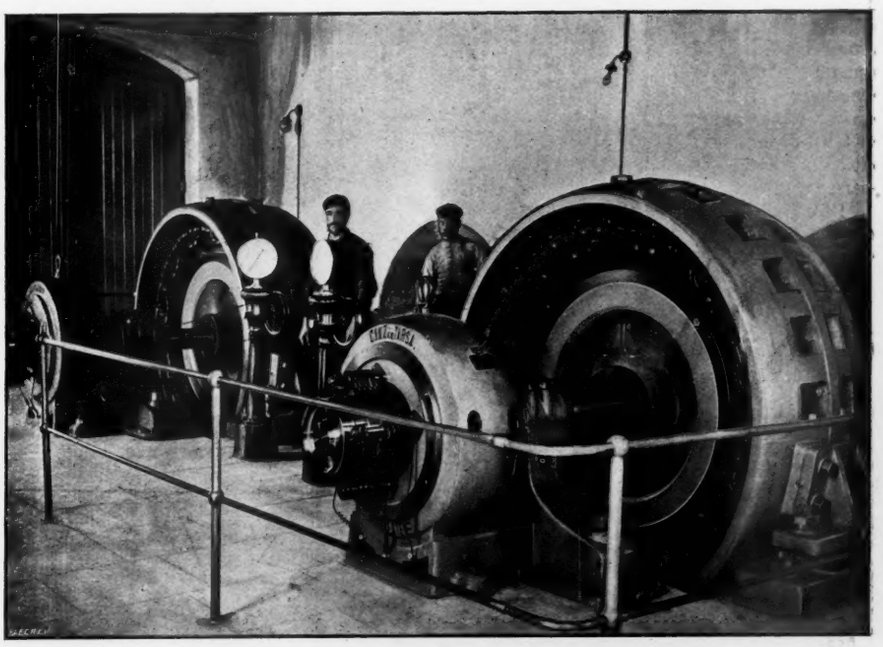
The plant in question has been installed by the Lake Copais Co., Ltd., an English company that has successfully completed the drainage of the Lake Copais, and it will be used primarily for the purpose of pumping. It is intended, however, to further use the power for the agricultural development of the land, and incidentally for the lighting of offices and driving small machines.

The district of the Copais is supplied with water from the east and north sides of Mount Parnassos, from the north of Mount Helicon, and generally from all the mountain ranges surrounding the plain. The chief source of water, however, is the River Melas, which maintains almost a constant supply both summer and winter.

The supply of water is enormously increased in the winter by the River Cephissus and the numerous streams that then spring into existence. For the purpose of drainage all these waters are collected and discharged through a tunnel in the mountains on the east into the adjacent basin of Lake Likeri. Between the tunnel exit and the level of the lake there is an average fall of between 8 and 9 metres, and it was here that the company decided on erecting their power house.

The necessity for pumping in the Copais is only of comparatively recent date, and is due to the curious fact that some of the interior parts of the old lake bed have settled to a level below that of the drainage canals; it consequently becomes necessary in winter time to pump the water that would otherwise lie in these hollows, to such a level that it will flow down the original water ways. This was recognised by Mr. Steele, the manager of the company in Greece, some time back, and a temporary pumping station consisting of Gwynne pumps, driven by portable engines, was installed.

The capacity of the pumps, however, was not large, while the cost of supplying the boilers with coal was excessive, so that eventually the present scheme of a permanent pumping station, obtaining its power from the fall of water eight miles away, was suggested by Mr. Steele, and adopted as likely to be the most economical and satisfactory.



Interior of Power House: Generating Plant.

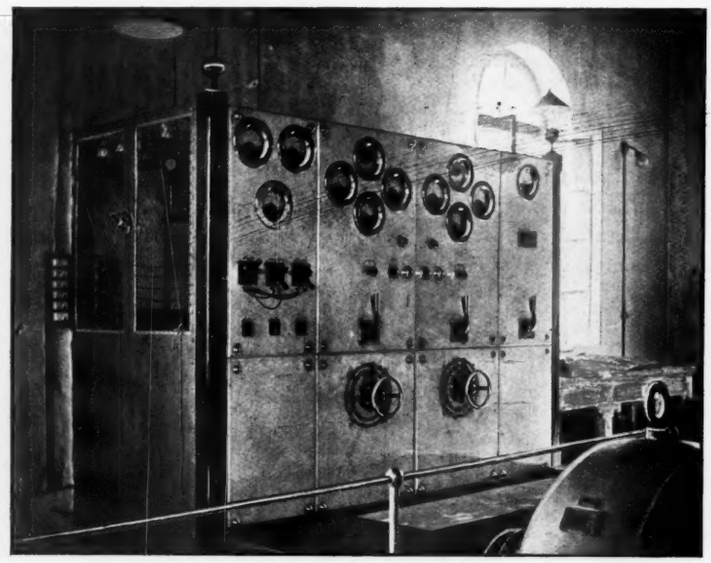
The power house, with its head-race, tail-race and all hydraulic work, has been built throughout with stone, the mortar consisting chiefly of a native pozzolana cement,

* Since this was written this station has been put in operation, and is now supplying both light and power.

except where great strength is needed, in which case Portland cement has been used.

Transmission Line.

The turbines, two in number, were manufactured by Messrs. Ganz & Co., Buda-Pesth; they are of the Francis horizontal type, and are designed for a head varying between 7 and 8 metres. They are virtually duplex with a common discharge, and in this manner all thrust due to the pressure of the water is neutralised. Regulation is effected from inside the power house, through a lever system actuating a series of movable guide blades. The guaranteed efficiency from full to three-quarter supply is 80 per cent., and at half gate 75 per cent.



Main Switchboard.

Directly coupled to the turbines are two 130-KW. three-phase generators running at 210 revolutions per minute. These are also by Messrs. Ganz and Co., and are of their well-known revolving field type. The voltage of the generators is 5,000 volts between any two phases, the stator windings being very amply insulated in micanite tubes and connected in star fashion.

The poles of the field magnets are of steel, wound with flat copper strips, while the exciting current is obtained from a four-pole exciter carried on an extension of the main shaft.

The leads from the machines are carried on porcelain insulators along a tunnel underneath the floor to the back of the switchboard, and from here the 5,000 volts is delivered direct to the line. No transforming is resorted to, and at the pumping station the current at 5,000 volts is led directly to the motor terminals, thus considerably simplifying all connections.

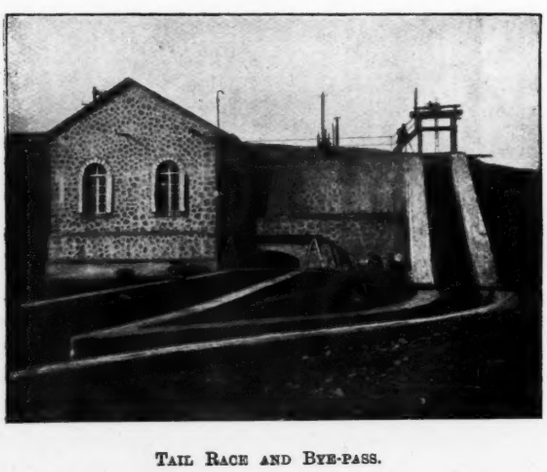
The transmission line consists of three wires of soft electrolytic copper of a section of 16 mm², carried on five-petticoated porcelain insulators, the insulators being arranged two on one side of the pole and the third midway on the opposite side. The poles are of creosoted wood, 7·65 m. above the ground level and 1·75 metres below.

At all road crossings a special erection has been made, which consists of insulated wires suspended by porcelain insulators from steel span wires.

Below the transmission line, at a distance of 1·50 metres from the bottom wire, is carried a telephone line; this line is very carefully insulated, and is crossed over every six poles. It has proved to be entirely free from all induction effects.

When the transmission line enters the station, it is carried on two poles bolted on the walls of the building; from here connection is made to three horn lightning arresters, and insulated cable is admitted to the interior through large micanite tubes cemented in the walls with gypsum. The distance of transmission is 13 kilometres, and with both pumps working the loss in the line is only 6·3 per cent.

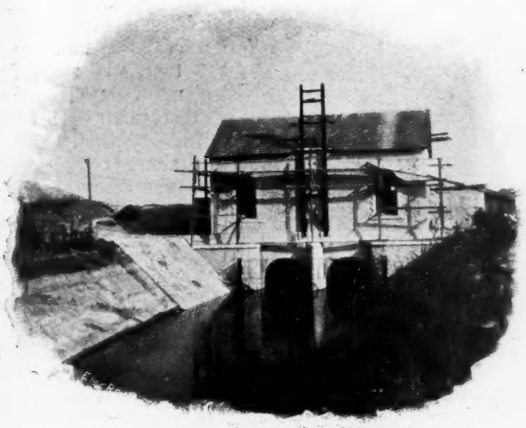
The pumping station, like the power house, is built throughout in stone and cement. It contains two induction motors of 80 B.H.P. each, running at 490 revolutions per minute, direct coupled to two centrifugal pumps; the capacity



Tail Race and Bye-pass.

First-pole, with Lightning Arresters.

of the pumps is 760 litres per second each, or 10,000 gallons per minute, with a lift of 4 metres.



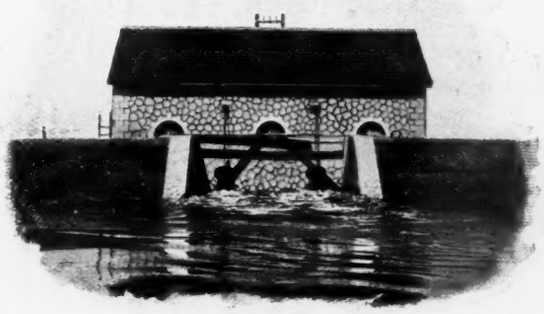
Pumping Station—Intake.

In order to secure the attendants from all chance of accident from the high-pressure currents, the leads to the two motors are carried in a trench under the floor and then in an iron casing to the motor terminals.

In front and behind the switchboard, at both the power house and the pumping station, a wooden platform carried on massive porcelain insulators is erected. Should, therefore, through any mischance, the insulation of the switches break down, or the pressure in any way get on to the switchboard frame, the attendant is in no danger. In addition, of course, to this precaution, all the ironwork of the switchboards and machines is very carefully earthed in the usual manner.

The switch gear, in accordance with Messrs. Ganz and Co.'s usual practice, all operates behind the board. The switches are of the ordinary three-pole quick-break horn type, while the fuses are carried in a weighted fibre tube which is itself encased in a massive ebonite handle.

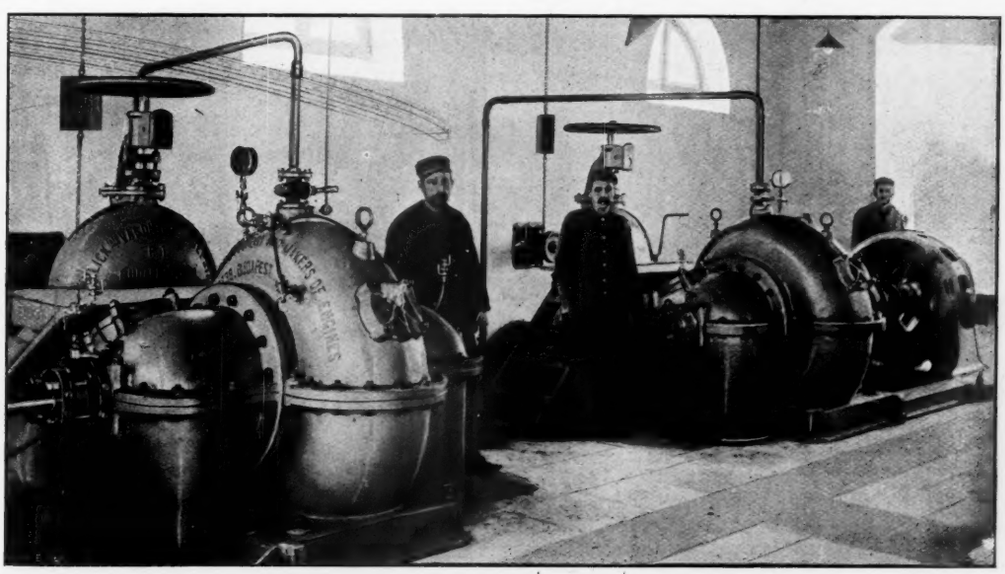
The whole plant has now been constantly at work for six months, and it says much for its simplicity that the attendants are men who have had no previous experience of electrical machinery whatever.



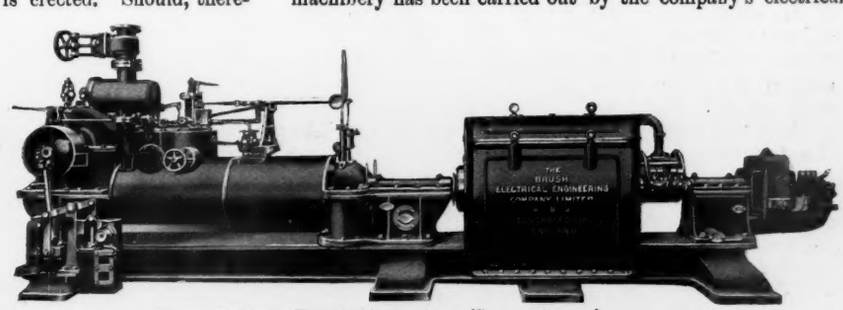
Pumping Station—Discharge.

The whole of the machinery for this scheme, including the turbines, generators, pumps, motors, switchboards and overhead equipment, has been supplied by Messrs. Ganz & Co., of Buda-Pesth.

The erection of all the buildings, hydraulic work and machinery has been carried out by the company's electrical engineer, Mr. C. McCarthy-Jones, while the consulting engineers for the scheme were Messrs. Burstall & Monkhouse, of Westminster.



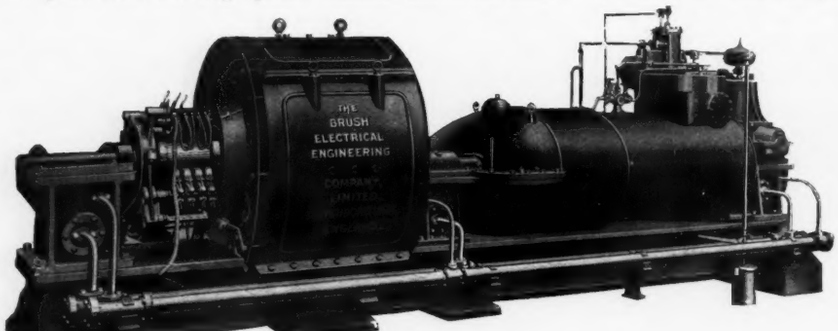
Interior of Pumping Station.



Brush-Parsons Turbo-Alternator (See next page).

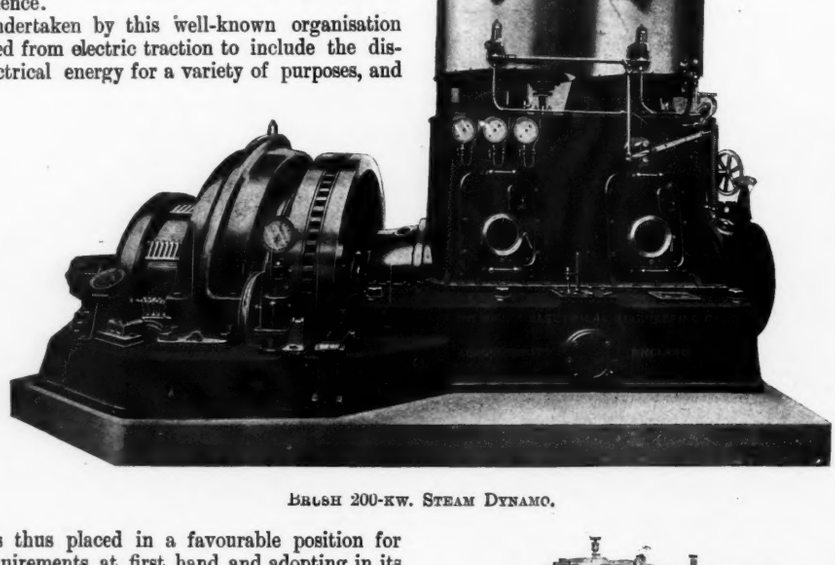
NEW PLANT FOR POWER STATIONS.

For some time past the Brush Electrical Engineering Co., Ltd., has been devoting special consideration to the steam engine and to the generator in relation to modern developments in electric power and traction work, of which, as one of the associated undertakings of the British Electric Traction Co., it has somewhat exceptional opportunities of obtaining experience.



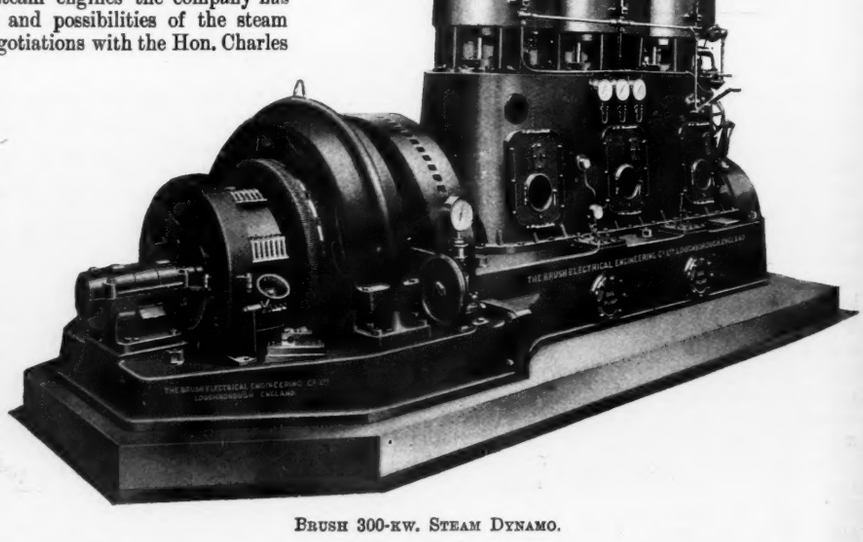
Brush-Parsons Turbo-Dynamo.

The work undertaken by this well-known organisation has been extended from electric traction to include the distribution of electrical energy for a variety of purposes, and the Brush Co. is thus placed in a favourable position for studying the requirements at first hand and adopting in its manufactures the latest improvements.



Brush 200-kw. Steam Dynamo.

Considerable progress has been made in this direction during the past year. For steam engines the company has investigated the advantages and possibilities of the steam turbine, and as a result of negotiations with the Hon. Charles Parsons a license has been arranged. The Brush-Parsons turbine now being constructed at Loughborough embodies the experience of nearly 20 years of its original designers and manufacturers. Within the past few years the demand for large power units for polyphase work has been very considerable, and the turbine has had opportunities of demonstrating its peculiar fitness for this work.



Brush 300-kw. Steam Dynamo.

The tendency for large power stations to be placed outside the area of supply has perhaps rendered space occupied by machinery of less importance. However, the cost of buildings remains, and the advantage in having a 3,000-h.p. engine weighing complete with generator 85 tons, over one of similar power weighing 400 tons, needs no emphasis.

The actual floor space occupied by turbine and generator combined is in the ratio of 2 : 3 as compared with a vertical reciprocator, and 2 : 5 in the case of a horizontal. The weight of the heaviest part of a turbine of 3,000 h.p. is only about 7 tons, whilst the flywheel alone of a reciprocating set of this power scales 140 tons ; if in two parts, it is still 70 tons, almost equal to the whole weight of turbine and dynamo combined.

Like most new departures, the steam turbine has had to encounter much inertia and some hostility, but it is claimed that the best reply to the criticisms which have been advanced is the number now at work, running daily, and maintaining the same steam consumption as when first tested on erection, not by the makers only, but by experts whose testimony is beyond question.

An engine of 3,000 H.P., with only two wearing parts, the main bearings each supporting only 2½ tons of rotating steel, perfectly balanced, without thrust or pull, appears to be an ideal achievement. The machine requires no internal lubrication—not, it is explained, at the sacrifice of efficiency of material, but because there are no parts in contact under steam. This is said to effect a saving of some 16s. per diem for cylinder oil alone, on a 2,500 H.P. set, as compared with high-class reciprocators. It would appear incidentally that the old trouble of damage to boilers by oil is avoided.

The wear of parts is found to be negligible, a pair of bearings will wear for two or three years, and the reduction of journal and white metal can then be measured only in $\frac{1}{10000}$th parts of an inch. The chief charge against a turbine is that there must be deterioration due to the cutting action of the steam. *Primâ facie* this should be the case, but as the fall of pressure between successive turbines is only about 2 lbs. per sq. in., wear seems to be hardly possible.

It is, we believe, generally admitted that in general principle the turbine more nearly approaches the ideal steam engine than earlier types. The only limits to the range of temperature which can be made use of, are the difficulties of obtaining in practice steam of a higher temperature than 800° F., or lower than that corresponding to a pressure of ½ lb. absolute. The final temperature (contrary to piston engine practice) cannot be pushed too far. The difference in economy between exhausting at 2 lbs. absolute and 1 lb. is 9 per cent.

In regard to steam economy, the builders appear to have great confidence, as we understand that they are prepared to make engines for small sizes equal in every respect, and for large plants superior to other types. The Brush Co.'s extensive works at Loughborough are well adapted to the manufacture of this type of machine, and new plant is being put in capable of building up to 10,000 KW. sets.

Concurrently with the production of the turbine, the company is bringing out for coupling thereto a new line of alternators, and of direct-current machines, particulars of which will shortly be made public. We are informed that the alternators are self-exciting, parallel with special facility, can be compounded or even over-compounded, and that the actual drop with any power factor is only 3 per cent.

For alternating currents a high speed lessens, of course, the number of poles and of armature coils, and it appears that the reduction of weight of a turbo-alternator is perhaps due more to the alternator than to the turbine, when compared with a reciprocating set alone. The turbo-alternator can be built with a rotating armature for single, for two, or for three-phase up to 2,500 volts, giving lighter rotating parts and higher efficiency. Beyond this pressure a rotating field magnet is desirable.

The paralleling of these machines appears to be successful, and we understand that in most cases the alternators have fallen into step upon the first trial runs. At one station turbines are running daily with no less than five different designs and builds of alternators, with iron cores, coreless armatures and inductors.

Of recent years the manufacture of continuous current turbo-dynamos has much improved, and for traction work it has certain advantages, the high speed affording a ready response to the sudden demands for power.

The Brush Co. is equipping its testing department with boilers, superheaters and condensers, capable of running plant of 2,000 to 3,000 H.P. on the works, and it will be possible to show engineers tests of their purchases in a more ready fashion than usually can be arranged on the site.

Illustrations of an alternator and continuous current machine are here given, the former of a capacity of 300 KW., 2,000 volts, 50-period single-phase, with exciter combined, and the other a 500-volt continuous current machine specially designed for public supply on a heavy motor and lighting load.

In addition to the Brush-Parsons steam turbine the Brush Co. is now building a double-acting, enclosed high-speed reciprocating engine. No novelty is claimed for it, but especial attention has been directed to combining the favourable experience gained in the use of many engines of this class. For powers up to 200 H.P. a reciprocating engine is considered to be somewhat more economical than a turbine, unless geared, a course open to many objections.

The illustrations show two of larger size—a 300-KW. three-crank and 200-KW. two-crank, both compound. This pattern has been subjected to a long continuous daily run, on motor and lighting load. The dynamos attached are of the latest type, designed for the British Electric Traction associated companies.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 784.)

Manchester Telephones.—Mr. W. E. L. Gaine, manager of the National Telephone Co., lately wrote to the Manchester Corporation complaining of "the very serious position which has been created in connection with the telephone system in Manchester consequent upon the impediment, now nearly a year in duration, which has been placed in the way of the company proceeding with its works." The position, the manager added, has now become so acute, owing to the company being unable to meet the public demand for telephone service, that the board has felt compelled to give instructions for the overhead works to be proceeded with forthwith, failing authority being obtained from the Corporation to proceed with the requisite underground works. To the company it seemed an extremely foolish thing to force them into putting a mass of overhead wires across the electric trolleys. This letter led to a resumption of negotiations, and representatives of the Corporation, including the chairman of the Tramways Committee, have been appointed to meet representatives of the National Telephone Co., with authority to deal with the matters arising out of the correspondence.

Pacific Cable.—Mr. Chamberlain, in reply to a House of Commons question, says that this cable has never been interrupted, though certain interruptions have taken place in its connecting land lines in Canada. These interruptions occurred on five occasions, and have involved a suspension of communication for 147 hours.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	
Trinidad-Demerara No. 1	Aug. 27, 1901	
Dominica-Martinique	May 8, 1902	
St. Lucia-Martinique	May 8, 1902	
Guadeloupe-Martinique	May 9, 1902	
Martinique-Puerto Plata	July 10, 1902	
Guantanamo-Mole St. Nicholas	Aug. 4, 1902	May 4
Cayenne-Pinheiro	Aug. 13, 1902	
St. Lucia-St. Vincent	Sept. 19, 1902	
Reissa-Issa	Oct. 22, 1902	
Reissa-Yemani	Oct. 22, 1902	
Paramaribo-Cayenne	Feb. 27, 1903	
Jamaica-Colon	March 12, 1903	May 4
New York-Haiti	April 13, 1903	
St. Jacques-Haiphong	April 17, 1903	May 5

Wireless Telegraphy.—Mr. Brodrick has informed Sir John Leng, in answer to a Parliamentary question, that the Admiralty wireless telegraph instruments in Somaliland were used to establish communications in certain cases, in one case to the extent of 32 miles, in spite of very exceptional difficulties. The results, however, were not, in the opinion of the general officer commanding, sufficiently certain to justify the further carriage of the instruments, which had led to exceptional difficulties of supply and transport.

Legal proceedings as to priority of invention are said to be pending between the owners of the Braun-Siemens method, and the Allgemeine Electricity Co., which controls the Slaby-Arco system of wireless telegraphy, but it is possible that an agreement will be arrived at eventually.

CONTRACTS OPEN AND CLOSED.

OPEN.

Basingstoke. — May 8th. The Corporation invites tenders for a 21 years' lease of the electric lighting order. See "Official Notices" April 24th.

Belgium.—May 29th. Tenders are being invited until May 29th by the municipal authorities of Charleroi for the electric lighting of the town. Tenders are to be sent to l'Hotel de Ville, Charleroi, whence particulars may be obtained.

Belgium.—Tenders are at present being invited by the Belgian State Railway Authorities at La Bourse, Brussels, for the the supply of 34 continuous-current motors, ranging in power from 1 to 25 H.P., one 165-KW. shunt-wound continuous-current dynamo, one ditto of 200-KW. capacity, two compensating 175-KW. dynamos, and two ditto of 20-KW. capacity.

Brighton.—June 8th. The Council wants tenders for 5,400 KW. generating plant at Southwick power station, and 5,000 KW. motor-generator converting plant, together with switchboards, instruments, &c., at North Road power station. See "Official Notices" April 17th

Cairo (Egypt).—May 12th. The Egyptian Government is inviting tenders for an installation for the transmission of power for public and private purposes at Ghiza and Jhezira. See this column for April 3rd.

Felixstowe.—May 16th. Cables, arc lamps and poles, for the U.D.C. See "Official Notices" May 1st.

Foot's Cray.—The Council is inviting offers from parties willing to work the prov. order under lease. See "Official Notices" to-day.

Germany.—The Werdau Municipal Council invites tenders for erection of electricity works for supplying current to Werdau and Cremmitschaw.

Gloucester.—June 16th. Generating plant (two 200-KW. sets), condensing plant, pipework, switchboard, battery and boosters for the city light railways. See "Official Notices" to-day.

Govan.—May 8th. Stores for the electricity department. See "Official Notices" May 1st.

Govan.—May 18th. Steam dynamos, boilers, superheaters, stokers, economiser, cooling tower and condensing plant, piping and electric crane. See "Official Notices" May 1st.

Hornsey.—May 11th. Joint boxes for the U.D.C. electricity works. See our "Official Notices" May 1st.

Hungary.—May 31st. Tenders are invited by the municipal authorities of Veszprem for the lighting of the town either by gas or electricity.

Islington.—May 27th. Alternating current transformers. See "Official Notices" April 24th.

Johannesburg.—June 8th. Rails, points and crossings, tie-bars, &c., for the electric tramways. See "Official Notices" May 1st.

Leyton.—May 13th. Low-tension cables. See "Official Notices" April 24th.

Rangoon.—July 1st. The Municipal Committee wants tenders for carrying out its electric lighting license, and particulars, forms, &c., can be obtained from the officiating secretary (W. Shircore), Rangoon municipality, at Rs. 75 per set.

Spain.—May 25th. The Spanish Post and Telegraph Authorities in Madrid are inviting tenders until the 25th inst. for the supply of 60 tons of iron telegraph wire 4 mm. diameter. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, 10, Carretas, Madrid.

Stockport.—May 13th. Steel structural work for the Millgate electricity station. See "Official Notices" April 24th.

Stockport.—May 18th. Overhead equipment for tramways extensions. See "Official Notices" to-day.

Willesden.—May 12th. Arc lamp carbons for the electricity department. See "Official Notices" May 1st.

CLOSED.

Axminster.—For installing the electric light in the Workhouse:—

Sphere Electrical Co., Bristol	£891
Edwards & Armstrong, Bristol	848
Winter & Co., Bristol	788
W. J. Webber, Bristol	778
Witting Bros. (accepted)	670

Bridgend.—Messrs. Mills, English & Co., of Swansea, have secured the contract for the complete two-phase motor installations for the Bridgend Asylums, Glam. The motors vary in size from 10-B H.P. to 2-B H.P., and will all be of Westinghouse make.

Crewe.—Messrs. Willans & Robinson, Ltd., have received an order from the London & North-Western Railway Co. for two 165-H.P. triple-expansion engines for dynamo driving.

Coventry.—The T.C. has accepted the tender of Messrs. Stuart & Moore, electrical engineers, for the installation of electric fire call bells at £183 15s.

Derry.—The Corporation has accepted the following tenders in connection with the scheme for supplying private electric lighting and power:—Victor Coates & Co., Belfast, £3,900, for Lancashire boilers; British Thomson-Houston Co., £4,700, for steam dynamos; Electrical Power Storage Co., £900, for storage battery; Cox-Walkers, £900, for switchboard; Porte & Co., £146, for overhead travelling cranes; Western Electric Co., £9,300, for conduits, cables, troughs, sheaths, &c.

Halifax.—The Tramways Committee has accepted the tender of Mr. J. W. Walker, of Halifax, for fitting up 12 new tramcars with his patent dry seats at £13 per car.

Hanley.—The T.C. has accepted the tender of Messrs. Whitehead Bros., for a furnace to one of the boilers at the electricity works, at £70.

Hastings.—The T.C. has accepted the tender of Messrs. C. A. Parsons & Co., for a spare armature for a turbo-alternator, at £381.

Liverpool.—The E.L. and P. Committee has recommended the City Council to accept the tender of Messrs. W. Thornton & Sons, Liverpool, for the erection of a new generating station on ground in Lister Drive, contiguous to the present generating station. The contract price is £52,375. The Committee has also recommended the Council to accept a tender from the British Westinghouse Electric and Manufacturing Co, Ltd., for the supply of two steam-driven generators.

London.—The London County Council has received the undernoted tenders for the supply of 11 overhead travelling hand cranes for use at the New Cross and Camberwell sub-stations:—

Herbert Morris & Bastert, Ltd., Loughborough *	£1,560
Paul Hengeau (Le Titan Anversois, Ltd.), London	1,634
Herbert Morris & Bastert, Ltd., Loughborough *	1,668
Carrick & Ritchie, Edinburgh (accepted)	1,700
John Hitchen & Son, Halifax	1,810
Frederick Bird & Co., London	1,998
W. McKinnon & Co., Aberdeen	2,087
Jessop & Appleby Bros., Leicester	2,130
Flavell & Churchill, London	2,176
J. M. Henderson & Co., Aberdeen	2,201
John Smith (Keighley), Ltd., Keighley	2,292
Marshall, Fleming & Jack, Motherwell	2,330
Baxendale Bros., Manchester	2,401
A. T. Bennett & Co., London	2,446
Bedford Engineering Co., Bedford	2,485
C. & A. Musker (1901), Ltd., Liverpool	2,495
Higginbottom & Mannock, Ltd., Manchester	2,547
James Carrick & Sons, Ltd., Edinburgh	2,599
Joseph Booth & Bros., Ltd., Leeds	2,605
Pickerings, Ltd., Stockton-on-Tees	2,711
Mid-British Co, Cradley Heath	2 787
James Spencer & Co., Manchester	3,260
Isles, Ltd., Leeds	3,787
Higginbottom & Co., Ltd., Liverpool	3,792
Tangyes, Ltd., Birmingham	4,440

* Not according to specification.

Peterborough.—A contract for a 240-KW. traction generator coupled to a Bellis engine has been placed with Messrs. Crompton & Co., Ltd.

Tynemouth.—The War Office has given the order for the supply and erection of a storage battery required at Spanish Battery, Tynemouth, to the Hart Accumulator Co., Ltd.

Walton-on-Naze.—The Hart Accumulator Co. has secured the contract for the supply of a storage battery required for the electric lighting works.

FORTHCOMING EVENTS.

Friday, May 8th.—At 5 p.m. Physical Society. "A Spectroscope of Direct Vision and Minimum Deviation," by Mr. T. H. Blakesley; "Note on the Construction and Attachment of Galvanometer Mirrors," by Dr. W. Watson.

Monday, May 11th.—At 8 p.m. Society of Arts. "Mechanical Road Vehicles," by W. Worby Beaumont. (Cantor Lecture III.)

Thursday, May 14th.—At 8 p.m. I.E.E. at Society of Arts, John St., W.C. "Applications of Electricity in Engineering and Shipbuilding Works," by A. D. Williamson; "Electric Driving in Machine Shops," by A. B. Chatwood. (Adjourned discussion.)

Tuesday, May 19th.—At 8 p.m. I.E.E (Glasgow). Annual General meeting. "Three-Phase High-Voltage Electric Railways, with special reference to the Valtellina Railway," by M. T. Pickstone; adjourned discussion and lantern views of the line. "Commutator Design," by W. B. Herd.

ELECTRICITY IN MINES.

THE hearing of evidence on the above subject was resumed on the 29th ult. by the Departmental Committee at the Home Office, under the chairmanship of Mr. Cunynghame. Evidence of a general character was given by Prof. Henry Lewis, Professor of Mining, Durham College of Science, in the early part of the day, and was followed by that of Mr. W. M. Garforth, M.I.C.E., Past President of the Midland Institute of Mining Engineers, who, as managing director of Messrs. Pope & Pearson, Ltd., had carried out experiments at the suggestion of the Mining Association of Great Britain, with a view to determining whether an electrical coal-cutter can be made as safe to use at the working face as a safety lamp.

The experiments were to decide (1) Whether an open-type electric motor can work with safety in explosive

atmospheres; (2) Similarly in the case of a gas-tight enclosed motor; (3) Whether inward leakage would occur in the case of a gas-tight enclosed motor, standing in an explosive atmosphere for several hours, in sufficient quantity to cause an internal explosion; (4) Whether, in the case of the previous internal explosion, the surrounding explosive atmosphere would be affected; (5) Whether electric motors covered with two thicknesses of safety-lamp gauze can be run with safety in an explosive atmosphere; and (6) In the case of a breakdown in a coal-cutting motor, in which a leakage occurred to earth, whether the ordinary vibration would cause dangerous sparking at the rails.

For the purpose of the experiments a specially explosive gassy atmosphere was produced, and every care taken to obtain reliable results. It was found that, in every instance, the open-type motor, running without load, would ignite the gases, and it was inferred that its use in such a situation would be unsafe.

In the second case, an enclosed motor was run for an hour in an explosive atmosphere without an explosion taking place, and it was concluded that coal cutters with enclosed motors and switch boxes could be made to run without igniting a gassy atmosphere, these tests being far more severe than anything found in actual mining.

In the third case, the results led to the conclusion that an explosive atmosphere may percolate into a gas-tight enclosed motor, and that it is advisable, after a stoppage of the ventilating fans, to remove the motor covers and allow any accumulated gas to escape.

The fourth experiment tended to show that an internal explosion in a motor would not ignite the external atmosphere.

In the fifth case, where two gauze covers were employed, the motors were found to work about 20 minutes without explosion; beyond that time the gauze became so heated as to pass flame, which would permanently injure the insulation of the motor.

In a further case where five gauze covers suitably arranged were tried, an internal explosion was found to burn wool placed over the outside of the covers.

The sixth case showed that sparks given off at the floor were not likely to fire the gas, which is generally near the roof, and which would in any case previously affect the lamps and warn the men to leave the workings, and stop the machinery. Mr. Garforth further stated that he had used electric signalling over long distances underground for the past 19 years—and electric lighting had been used for some 16 years—during which time no person had been injured from this cause.

NOTES.

National Telephone Co.'s Dinner.—The tenth annual dinner of the National Telephone Co.'s staff was held on Friday last at the Trocadero Restaurant, under the chairmanship of the general manager, Mr. W. E. L. Gaine. Amongst those present were Lord Harris; Mr. Geo. Franklin, the vice-president of the company; Sir James Fergusson, M.P.; Sir Albert Rollit, M.P.; Mr. Frank Edwards, M.P.; Messrs. Wm. Alex. Smith; W. Vincent Hill; Albert Anns, secretary; Frank Gill, engineer-in-chief; and other officials from all parts of the United Kingdom, representing upwards of 11,000 employés. In all there were about 140 guests.

After the loyal toasts had been duly honoured, Mr. F. D. Watson proposed "The Houses of Parliament," and referred feelingly to the sad loss of Mr. Hanbury. Lord Harris, in reply, upheld the House of Lords as a useful institution, pointing out that the choice lay inevitably between aristocracy and plutocracy, of which the former was the least objectionable. Sir James Fergusson replied for the House of Commons, which, he said, had not done the company much harm! He hoped that Parliament would see the advisability of prolonging the existence of the company, and paid a tribute to the industry and ability of the staff and employés.

The Chairman, proposing the "National Telephone Co.," alluded to the loss, during the past year, of the services of Mr. Dane Sinclair (who was present), and expressed the good wishes of the company towards him in his new sphere. The change had enabled them to recover Mr. Cook (from the Western Electric Co.), while the board of directors had made an excellent choice in appointing Mr. Frank Gill engineer-in-chief. The company was now working 1,050 exchanges, an increase of 25, with a *clientèle* of more than a quarter of a million, representing an increase of 26,000 subscribers. During the year 844 million messages had been sent, an increase of 56 millions. These figures showed a great development, but were no indication of what the company could have done if it had had the chance. The restrictions under which they laboured were heart-breaking, but they hoped for an improved position in the future. Competition was not a suitable method of developing the telephone service. As for Tunbridge Wells, he would sound no pæan of triumph—that was only an example of the outcome of foolish competition. In Glasgow they were in competion with a great municipality, and neither the company nor the Corporation yet knew the financial results of the struggle. The company was stronger than ever, having 12,000 subscribers as against 8,000 for the Corporation: 40 per cent. of the subscribers were compelled to subscribe to both systems. In London they were in competition with their masters; the Post Office was doing very well, adding to its numbers by 150 to 200 a week; meanwhile the company was adding 240 a week, a rate which was still maintained. The competition in London was not injurious to the public, as it was in Glasgow, as there was free intercommunication between the two systems. Telephony was essentially a monopoly, whether in the hands of the State or of a company, and he thought the Government would one day recognise this fact.

Mr. George Franklin, replying to the toast, expressed the regret of Sir Henry Fowler at his unavoidable absence, and Sir Henry's admiration (which he shared) for the diligence of the staff. The company had surmounted many difficulties, of which the latest was "municipal trading," a form of competition between a community and its own ratepayers, and therefore disastrous. Their efforts must be devoted to giving the best possible service to the public.

Mr. Frank Gill, proposing "Our Guests," regretted the absence of representatives of the Post Office staff.

Sir Albert Rollit, in reply, said he had spent the evening with the Deceased Wife's Sister, and proceeded to keep the company in roars of laughter by comical anecdotes alternating with sage maxims. Sir Albert concluded with an eloquent peroration on the magnificence of the electrical engineering profession, relating his recent experiences at Niagara, where amongst other things he had seen the "turbines driven by dynamos." "Knowledge is Power," he said; but we cannot be hard upon his trifling slip after hearing his speech.

Last of all, Mr. E. J. Hidden in eulogistic terms proposed the health of the "Chairman," who responded briefly, and the proceedings terminated.

The speeches were interspersed with a capital programme of songs and sketches.

International Telegraph Conference. — Invitation cards, in the name of the President of the Institution of Electrical Engineers, are being issued to members of the Institution for a concert to be given at the Royal Albert Hall on the evening of Thursday, June 11th, during the meetings of the International Telegraph Conference.

Institution of Electrical Engineers' Conversazione.—As announced at the last meeting of the Institution, the annual conversazione of the Institution of Electrical Engineers will be held at the Natural History Museum on the evening of Tuesday, June 23rd. This date has been selected as one on which it will be possible for the members of the International Telegraph Conference to be present. The Bird Gallery will this year be opened in place of the Gallery of Fossil Mammalia.

Dover Corporation Bill.—The National Electrical Contractors' Association has been in correspondence with the Town Clerk of Dover, and also with the Parliamentary agents for the Bill, and as a result of the strong position it has taken up on the question of the electrical clauses, the Corporation has agreed to delete the same. The Corporation was seeking powers in the clauses in question to set up "lamps, fittings, motors, apparatus and things," and has now agreed to restrict its powers to "meters and electric lines." It has agreed further to insert a clause in its Bill to the following effect:—"But the Corporation or its servants shall not be entitled to enter upon consumers' premises for the purposes of undertaking wiring or installation work." In consideration of these amendments the National Electrical Contractors' Association has agreed to withdraw all opposition to the Bill.

The Fire Congress.—The International Fire Prevention Congress, convened by the British Fire Prevention Committee, will be opened by the Lord Mayor on July 7th. The exhibition was opened on Wednesday.

Our Consuls.—Viscount Cranborne, at the suggestion of Sir Thomas Dewar, is considering the advisability of increasing the number of salaried consular officers representing the United Kingdom abroad.

Munificent Gift to Liverpool University. — It is reported that at a meeting of the governors of University College, Liverpool, last Saturday, it was stated that Mr. David Jardine, shipowner, had given £10,000 to found a chair of "Electrotechnics" in connection with the engineering department.

Royal Institution.—A general monthly meeting of the members was held on Monday, when it was announced that the president had nominated the following vice-presidents for the ensuing year:—Sir Benjamin Baker, Sir Frederick Bramwell, Lord Halsbury, Dr. D. W. C. Hood, Lord Lister, Mr. George Matthey, Sir James Crichton Browne (treasurer) and Sir William Crookes (honorary secretary).

Petrol Electric Omnibus.—This week the London General Omnibus Co. is making experimental runs with a Fischer petrol-electric omnibus to accommodate 30 passengers.

Lectures.—A course of lectures is to be delivered at the East London Technical College on Mondays, commencing on May 18th, on "Three-phase work"; Mr. J. Morris will be the lecturer.

Personal.—Mr. F. V. Brown has been appointed "outside superintendent" of switch work by Messrs. Ferranti, Ltd., Hollinwood, vice Mr. W. S. Toplis, resigned, who has joined the British Westinghouse staff.

Mr. Thos. Coates, senior tramways inspector at Oldham, has been appointed tramway traffic superintendent at that town.

The Postmaster-General has appointed Mr. George H. Duckworth to be his principal private secretary in the place of Mr. A. W. Coates, resigned through ill-health, and Mr. A. E. W. Codrington, of the secretary's office, to be his assistant private secretary.

Mr. C. W. Shepherd, who is leaving the tramway superintendentship of the Bradford Tramways for a similar position in Edinburgh, was last week the recipient of several valuable parting gifts from friends both inside and outside of the tramway department. Amongst those present at a dinner given in his honour were the Mayor of Bradford, the chairman of the Tramways Committee, and the tramways manager.

Appointments Vacant.—Resident electrical engineer for Todmorden at £250; a competent man accustomed to three-phase work is wanted for cable work at Rugby; resident electrical engineer at Horsham electricity works; superintendent of mains for Croydon (£100, rising to £150); traffic superintendent (£130) and chief inspector for Lowestoft tramways. See "Official Notices" to-day.

Institution of Civil Engineers' Conference.—The third of the series of engineering conferences arranged by the Institution of Civil Engineers has been arranged for June 17th, 18th and 19th, at Westminster. The proceedings will be inaugurated on June 16th by the delivery of the "James Forrest" lecture by Mr. W. H. Maw on the subject "Some Unsolved Problems in Engineering." Among the topics to be discussed are the following:—

"Apprenticeship in Engineering Education."

"The Relative Advantages of Overhead, Deep Level and Shallow Subways for the Accommodation of Urban Railway Traffic."

"Automatic Signalling."

"The Control and Administration of American Railways."

"The Modern Equipment of Docks, with special reference to Hydraulic and Electric Appliances."

"Recent Improvements in Canal Engineering."

"Internal Combustion Engines for Driving Electrical Generators."

"Speeds of Overhead and other Cranes as a Factor in Economic Handling of Material in Working."

"Use of Petrol Motors for Locomotion."

"Gauges and Standards as affecting Shop and Manufactory Administration."

"Percussive Coal Cutters."

"The Comparative Merits of Direct-Current, Alternating-Current and Three-Phase Systems for Shipyard Purposes."

"Steam Turbines."

"Smoke Abatement."

"Applications of Electricity to Driving Carriages in Towns."

"Transmission and Distribution by Single-phase Alternating Current."

"Wireless Telegraphy."

"High-speed Electrical Traction on Railways."

Visits to important electrical power stations and electrical engineering works will form part of the programme.

Prize for a Dust-Arresting Respirator. — The Council of the Society of Arts offers, under the terms of the Benjamin Shaw Trust, a prize of a gold medal, or £20, for the best dust-arresting respirator for use in dusty processes, and in dangerous trades. The provision of such apparatus is considered as essential in many industries by H.M. Inspectors of Factories. We understand that the Secretary of State for the Home Department, the Right Hon. A. Akers-Douglas, has expressed his satisfaction that the offer has been made, and remarks that "an efficient means of arresting dust, without impeding the workman, is much wanted." Inventors intending to compete must sent in specimens and full descriptions to the secretary of the Society of Arts, John Street, Adelphi, W.C., by December 31st, 1903.

Claim against the B.I.W.—At Dublin on April 30th, before Mr. Justice Madden and a special jury, Mr. James Timmons, of Dublin, sued the British Insulated Wire Co. for £2,000 damages for personal injuries alleged to have been sustained by him in consequence of having fallen into an excavation made in the ground at the North Wall, Dublin, last November, by the defendant company's servants. The defendant company denied the negligence. Plaintiff, who was about 60 years of age, was driving pigs down the North Wall, when one of them turned into an opening, and when plaintiff followed it he tumbled into a hole on the pathway. The ground had been opened up by the defendant company for the purpose of laying down electric wires for the Dublin Corporation, and plaintiff alleged that the excavation was without any protection on the occasion. After hearing plaintiff's evidence, the case was settled in Court, the company agreeing to pay plaintiff £125 as damages and £100 for costs, both parties to abide the costs of the special jury. The Court ratified these terms.

Institution of Civil Engineers.—Sir W. White has been elected president for the sessional year 1903-4. The council have made the following awards for papers read and discussed before the Institution during the past session:—A Watt gold medal to Mr. Bertram Hopkinson; Telford premiums to Messrs. Charles Hopkinson, B.Sc., and Ernest Talbot.

The Tramways and Light Railways Association.—Mr. Atherley-Jones, K.C., M.P., took the chair the other night at a dinner of the Tramways and Light Railways Association in the Westminster Palace Hotel. After sundry toasts, Mr. Philip Dawson read a paper on "Inter-Urban Communications," in the course of which he referred to the remarkable development of electric traction in this country. Mr. Dawson then briefly dealt with its history in America, and from the course of events drew conclusions as to what might reasonably be expected in this country. A discussion followed.

London County Council.—The Council decided at the meeting on Tuesday to lend £20,000 to the St. Pancras Borough Council for electric lighting, and £10,000 to the Stepney Council for similar purposes.

The Highways Committee reported that the Middlesex County Council, which had accepted a tender for the construction of a light railway from a point in Archway Road, near Highgate Archway, to Finchley and Whetstone, had asked when the London County Council proposed to lay its authorised tramway along the Archway Road. The Middlesex Council had suggested that as its light railways are to be on the overhead trolley system, the short length of tramway in the Archway Road should be constructed on the same system. As the Committee concurred with the suggestion, they had been in communication with the Islington Borough Council, which was prepared to give consent to the erection of posts and wires between the Archway Tavern and the county boundary. The Committee therefore asked for permission to prepare plans for the establishment of the overhead trolley system in the road in question.

It was stated by the Housing Committee that they had been quite unable to accept the terms proposed by the Mitcham and Wimbledon District Gas Light Co. for installing the automatic prepayment system for lighting the cottages on the Totterdown Fields Estate, Tooting. As a consequence, negotiations were entered into with the County of London and Brush Electric Lighting Co., which had agreed to wire and fit up the 276 cottages on the first section of the estate, and to supply electric light therein on the automatic prepayment system at the rate of 1d. for six hours' 8-c.p. light. The company will also keep the lamps in proper order.

Shock Fatality.—The *Review of the River Plate* says that a man was killed in Rosario on March 24th by catching hold of the high-tension wires. It appears that these had caught fire, on the roof of the Comedia Theatre, and he attempted to put out the fire by cutting the wires.

The Cape Town Exhibition.—So numerous have been the demands for space at this exhibition that a site 15 times as large as that originally fixed upon has had to be selected. It has also been resolved to postpone the exhibition for 12 months, viz., to November, 1904.

THE CENTRAL STATION ENGINEER.

A slight error occurred in our last issue:—Mr. B. Sankey, of Hackney (*not* Walthamstow) has been appointed chief *assistant* engineer, not chief engineer at Mansfield. Mr. E. Holcombe Hewlett is the borough electrical engineer at Mansfield.

Shipley U.D.C. has increased the salary of Mr. S. D. Schofield, electrical engineer, from £160 to £200.

Mr. H. G. Massingham, who recently resigned the position of the Exeter District Superintendent to the British Electric Traction Co., is the successful candidate out of 50 applications for the appointment of engineering clerk of works to the Exeter Corporation during the construction of the new generating station for tramways and lighting.

Mr. W. A. Wales, of the Glasgow Corporation Electricity Department, has been appointed chief assistant at Ashton-under-Lyne electricity works.

NEW COMPANIES REGISTERED.

Albion Products Co., Ltd. (77,178).—This company was registered on April 27th, with a capital of £20,000 in £1 shares, to carry on the industrial, experimental and commercial exploitation of any chemical and electro-chemical processes, the manufacture, purchase and sale of all products, and apparatus relating thereto, and in particular of carbide of calcium and similar products or products arising therefrom, and of primary materials for the same, including especially oxide of calcium, the study and exploitation of means for improving such products, the acquisition of patents relating thereto, the manufacture and sale of electro-chemical products and apparatus and of electrically and mechanically operated plant, and the business of electricians and engineers, &c. The first subscribers (each with one share) are:—C. J. H. Borr, 87, Hornsey Rise, N., gentleman; H. T. Hale, 13, Sackville Street, W., clerk; G. P. Cawston, Fernhill, Fillebrook Road, Leytonstone, accountant; A. J. Stringer, 1, Byrne Road, Balham, S.W., clerk; H. H. Rutter, 15, Ethelburga Street, Battersea Park, S.W., clerk; A. H. Hooper, 13, Eagle Mansions, Salcombe Road, Stoke Newington, clerk; and C. J. Little, jun., 17, Groombridge Road, South Hackney, N.E., clerk. No initial public issue. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; qualification, £100; remuneration as fixed by the company.

Yorkshire Electric Tramways Construction Syndicate, Ltd.
(77,167).—This company was registered on April 25th, with a capital of £280,000 in 180 preference shares of £1,000 each, and 10,000 ordinary shares of £10 each, to adopt an agreement with E. Scheck, to acquire any tramways, railways, light railways, telegraph and telephone lines, and electric, hydraulic or other works whether for the supply of power, light, energy or otherwise, to apply for any Parliamentary, municipal or other concessions or rights in the United Kingdom or elsewhere, to grant and accept any leases, licenses or other authorities for working tramways, railways, telegraph and telephone lines and the like, to erect, lay down and maintain all necessary works, buildings, cables, wires, accumulators, lamps, exchanges, telephones and apparatus connected with the generation, distribution, and utilisation of electricity, and to carry on the business of tramway, light railway, omnibus and van proprietors, carriers of passengers and goods, manufacturers of and dealers in rolling stock, vehicles, accumulators and dynamos, suppliers of electricity for any purpose, &c. The first subscribers (each with one share) are:—H. W. Brown, 68, Mackenzie Road, Beckenham, clerk; J. A. Fuller, 50, Chatterton Road, Finsbury Park, N., clerk; E. S. Harper, 97, Kelsake Road, Kensal Rise, W., clerk; T. Winter, 8, Montem Road, Forest Hill, S.E., secretary; H. J. Robinson, 88, Dean Street, Oxford Street, W., clerk; J. H. Riches, Alverstoke, 44, Shenley Road, Camberwell, S.E., clerk; and G. Troughton, 2, Bloom Park Road, Fulham, S.W., clerk. Minimum cash subscription 50 per cent. of the shares offered to the public. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £500. On the liquidation of the company the directors shall receive £3,000, divisible, as remuneration for the whole period of the company's existence. If the company shall not go into liquidation until after six months from incorporation, the directors may draw not more than £750 each half-year on account of the said £3,000.

Hammersmith, City, and North-East London Railway, Ltd.
(77,190).—This company was registered on April 28th, with a capital of £30,000 in £1 shares, to construct or acquire railways, tramways, vans, carriages, launches, steamboats and other vehicles and means of conveyance for passengers and goods by land or water (whether propelled by electricity, steam, oil, animal or other power), and to carry on the business of railway and tramway proprietors, carriers of passengers and goods, electrical, mechanical and marine engineers, contractors, suppliers of electricity, manufacturers of rolling stock, &c. The first subscribers are:—C. J. Wills, 71, Mosley Street, Manchester, railway and dock contractor, 3,000 shares; H. A. Earle, Salford Iron Works, Manchester, engineer, 3,000 shares; A. F. Hills, Thames Iron Works, Tidal Basin, E., contractor, 3,000 shares; H. H. Bartlett, Tredegar Works, Bow, E., contractor, 3,000 shares; R. L. Devonshire, 1, Fredericks Place, Old Jewry, E.C., solicitor, 10 shares; F. S. Monkland, 1, Fredericks Place, Old Jewry, E.C., solicitor, 10 shares; and A. W. Lipsham, 1, Fredericks Place, Old Jewry, E.C., clerk, 1 share. No initial public issue. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification (except first directors), one share; remuneration as fixed by the company. Registered office, 1, Fredericks Place, Old Jewry, E.C.

ELECTRICITY SUPPLY ACCOUNTS.

Oxford Electric Co., Ltd.

The Oxford Electric Lighting undertaking has had a successful year, in that the output has increased by 17 per cent. over the previous year, with a practically stationary average price per unit, while works costs have substantially decreased by £616 in total, and over ¼d. per unit. This has favourably affected the profit on the year's working, which is some £2,700 more than in the previous year. During the year the question of extending the generating station at Osney has been under consideration, and an addition to the boiler house completed.

The extent of the company's operations during recent years will be gathered from the following figures:—

Year ending Dec. 31st.	Equivalent 8-c.p. lamps connected.	No. of units sold.	Average revenue per unit sold.	Total cost per unit sold.	Dividend.
1898	25,928	374,033	5·81	2 99	5 per cent.
1899	29,538	426,720	5 73	2 96	5 ,,
1900	34,000	483,699	5 21	3·00	5 ,,
1901	40,458	569,561*	5·22	3 12	5 ,,
1902	46,010	668,177	5·20	2·44	5½ ,,

Of the total 668,177 units sold during the past year, private consumers took 620,594, and public lamps 47,583 units. The prices charged are—Private lighting, 6d., with discounts; power and heat, 4d. and 3½d. per unit. The total capacity of plant at the generating station is 825 kw. Mr. F. H. Francis is the chief engineer.

General Statement.

For year ending December 31st—	1901.	1902.	Inc.
Total capital expended ...	£111,164	£119,866	£8,802
Number of units sold	569,561	668,177	98,616
Maximum load in kw.	628	840	212
Equivalent 8-c.p. lamps connected	40,458	46,010	5,552
Number of public lamps ...	32 arcs. 48 incd.	32 arcs. 48 incd.	
Revenue Account—			
Gross revenue	£12,869	£15,008	£39
Gross expenditure	£7,412	£6,806	—£616
Gross profit	£5,457	£8,202	£2,745
Average revenue per unit sold ...	5·22d.	5·20d.	— ·02d.

Revenue Statement.

For year ending December 31st, 1902—	Gross.	Per unit.
By sale of energy	£14,424	5·20d.
Rental of meters	319	·11d.
Rents, fees, sundry	265	·09d.
Total revenue	£15,008	5·40d.

Working Expenses.

	Gross.	Per unit.
Coal and cartage	£2,103	·76d.
Oil, waste, water and engine-room stores ...	193	·07d.
Wages incurred in generation and distribution	1,492	·53d.
Repairs and maintenance of machinery, mains, buildings, &c.	1,027	·37d.
Works and distribution costs	£4,815	1 73d.
Rent, rates and taxes	588	·21d.
Management expenses, directors' fees, manager and secretarial salaries, &c.	865	·31d.
General establishment charges, printing, stationery, law, insurance, and audit fees, &c. ...	538	·19d.
Total works costs ...	£6,806	2·44d.

Profit Statement.

Debenture interest, &c.	£2,044
Written off hire purchase installation	554
Dividend on share capital	3,653
Reserve and renewals account	2,250
Balance carried forward	276
Balance from last account and hire purchase rents brought forward	—575
Gross profit	£8,202

To the gross profit of £8,202 on the year's revenue was added a sum of £575, being balance from last account and hire purchase installation rents, making a total of £8,777, which was allocated as shown, a balance of £276 being carried forward.

It will be noted that the reserve and renewal account has this year benefited to the extent of £2,250, making the small total of £4,500 contributed in 10 years for that purpose.

CITY NOTES.

Eastern Extension, Australasia and China Telegraph Co.

Sir John Wolfe Barry, K.C.B. (chairman), presided on Wednesday at River Plate House, Finsbury Circus, over the fifty-ninth half-yearly ordinary general meeting of the above company, and, in moving the adoption of the report, said the shareholders would admit that it was not unsatisfactory, although it presented some features of less marked prosperity than in some recent years. These were to some extent accounted for by the more normal conditions now prevailing in China and Manilla, and by the serious droughts which had occurred in Australia. The gross revenue for the half year amounted to £267,000 against £324,000 in the corresponding period of 1901, thus showing a decrease of £57,000. The figures for 1901, however, included £20,000 of exceptional revenue, such as profits on contract work and interest on loans and deposit moneys, so that the actual decrease in traffic receipts was about £37,000. Of this sum £24,000 was due to the Australian traffic, which had not yet responded to the reduction of tariff which they had made from time to time, and the remaining £11,300 was due to a considerable falling off in the Philippine traffic, which in 1901 was abnormally large from the war and political causes. The working and other expenses amounted to £121,869, against £120 294 for the corresponding period of 1901—an increase of £1,575, and this increase was made up of a number of small items. The net profit for the half-year amounted to £128,654, and after adding £73,000 brought forward, there was an available balance of £202,180. The usual interim dividend of 2s. 6d. per share was paid, and, with the final dividend, would make 5 per cent. In addition to this, a bonus of 4s. per share would be paid, making a total distribution of 7 per cent. for 1902. Of the balance of revenue, £30,000 had been transferred to the general reserve fund, and £37,180 carried forward to the next account. The 4 per cent. mortgage debenture stock had been increased in the half-year by £215,746 in order to meet capital requirements. This additional stock was issued at a premium which had been credited to the general reserve fund. The company's new repairing steamers, *Restorer* and *Patrol*, were completed in January last, and they were, perhaps, the two finest ships employed in telegraph work in the whole world. They had since been employed in transporting and laying the Dutch Government cable between Borneo and Celebes, and the company had been invited to tender for additional cables for the Dutch Government to connect Java, Borneo and Sumatra with the islands of Billiton and Banka. When these were laid they would act as feeders to the company's lines. The agreement entered into with certain of the Australian States when they conducted the Cape-Australian cable, provided for the reduction of tariff down to 2s. 6d. per word if a standard revenue was maintained. Unfortunately the standard revenue was not maintained during the past year, and consequently it was impossible to reduce the tariff from 3s. to 2s. 6d., as was hoped. Their irresponsible critics told them that, if they reduced rates, the traffic would be so

increased that the revenue would not be diminished; but experience showed them that those sanguine views were not borne out by facts, and that it took a very long time for them to recoup themselves. On January 1st, 1901, they reduced the Australian tariff from 4s. to 3s. 6d. a word. In 1901 they transmitted 1,912,000 words as compared with 1,866,000 words in 1900, so that practically the reduction had no effect at all. On January 1st, 1902, they further reduced the tariff to 3s. a word, and carried in that year 1,963,000 words, as compared with 1,912,000 words in 1901. This showed that the traffic was practically stationary, despite the reduction. The prospect of any further reduction in the Australian tariff must now be said to be extremely remote, owing to the revenue being adversely affected by the competition of the British Pacific Cable, which was opened on December 8th, and whose tariff was 3s. per word. One effect of the Pacific Cable would be to postpone *sine die*, the question of the reduction of the tariff. The traffic obtained by the Pacific Cable appeared to have been disappointing to its promoters, and it had been publicly announced that the Board expected a loss on the year of £95,000. That had naturally excited a good deal of grumbling in Canada and Australia, and an outcry had been received against the Eastern Extension Co. receiving fair treatment at the hands of the Australian Government. In fact, the supporters of the Pacific Cable who were all for competition, were now urging that there should be a monopoly in favour of the Government cable. He did not think there was any fear, however, of Australia listening to such a thing. On the contrary, the Federal Government, in accordance with the agreements, had placed at the company's disposal a special wire between Adelaide and Sydney for the transmission of their international traffic, and the company had opened public offices in Sydney, Adelaide and Perth to enable them to deal direct with the public in those cities. Since then the Federal Government had concluded an agreement with the company for extending the principles of the State agreements to the whole of the Commonwealth, and pending Parliamentary sanction of such agreement the company had been allowed as a tentative measure to work a special wire between Adelaide and Melbourne, and open a public office in the latter city. This action had displeased the friends and supporters of the Pacific cable, and a strong protest had been sent by the Governments of Canada, New Zealand and Queensland against the company having direct dealings in Australia, notwithstanding the fact that the principle was freely recognised in Australia, Canada, Great Britain and other parts of the globe. It seemed an extraordinary condition of things, that they should be allowed to deal direct with the public in so many other places, and that those gentlemen should protest against their being allowed to do so in Melbourne. He was glad to say, however, that Sir Edward Barton had publicly maintained that in entering into the new agreement the Federal Government were only safeguarding the true interests of the Commonwealth, and they were not disposed to unfairly support the unremunerative speculation of various governments as against securing a good service with the whole world, which the company was able to give. The Chinese telegraphs, which belonged to a private Chinese company under Government supervision, were a few weeks ago taken over formally by the Chinese Government, but the company did not anticipate that this important change would in any way affect the satisfactory relations which had existed for so many years, for they had been given an assurance that all the agreements and arrangements made with the old Chinese Co. had been taken over and would be recognised by the Chinese Government. Since he last addressed them sensational statements had appeared in the Press with regard to the development of wireless telegraphy. He scarcely wished to refer to the matter at all, and would merely say that nothing had happened and nothing had come to his knowledge to alter the opinion which he had from time to time expressed, that wireless communication was much more likely to be a valuable adjunct to submarine cable companies than to become a competitor. This view was evidently held in Germany, France, Holland, the United States and elsewhere, judging from the extensive projects emanating from those countries for new cables in all parts of the world.

The Marquis of Tweeddale seconded the motion.

Replying a number of questions and some criticism, the Chairman said, so far as they could see, the Pacific cable would take something like 25 per cent. of the traffic which passed between Australia and Europe. It did not, of course, affect their inter-Colonial traffic. It was, of course, a very serious matter for a private company to have 25 per cent. of its traffic taken away by the action of a State-aided enterprise, and it was one of those things which many people thought should not be allowed. There, however, was the broad fact, and it was certainly not a satisfactory result to the taxpayers, who would have to find £95,000 this year. He did not want to be a hostile critic of wireless telegraphy, and he believed it would be most useful for the shipping community, and also for the cable companies. In fact, they had installed some of their ships with wireless telegraphy, and one of their stations, and found it very useful for distances of 30 to 40 miles. It was quite true that the gross receipts of the company had fallen very considerable of late years, but they still paid 7 per cent., and added substantial sums to their reserve fund. This falling off was due to a great many causes, and one especially was the reduction in tariffs. These reductions they hoped would, in the long run, bring the revenue up, but experience had shown that it would take many years. They had now to face competition in many parts of the world where previously it did not exist, and the result was that the profit was diminished. At the same time the enterprise was in a very sound condition. They had never touched the reserve for equalising dividends, although of course it was used for renewing cables, and they had now a reserve fund of £393,000.

The report was then adopted.

Cuba Submarine Telegraph Co.

The meeting of this company was held on April 29th, Mr. George Keith presiding, in the absence of the chairman of the company, Mr. C. W. Parish.

The Chairman in proposing the adoption of the report, said he felt sure the shareholders would consider it a satisfactory one. It was by far the best report they had been able to present for some considerable time. The accounts were as usual, clearly set forth, and required very little explanation. The traffic receipts had been gradually improving throughout the half-year, with the result that they had an increase of £4,426 as compared with the corresponding period of 1901. Their business generally had improved, and they had had less competition owing to the continued interruptions of the Cuba—Hayti cable. Then in December, the Venezuela trouble contributed a large number of Press messages which accounted in a great measure for the traffic of that month coming out at over £3,000. The total traffic receipts for the half-year amounted to £13,696. Interest on investments amounted to £2,265, £18,275 had been recovered in respect of the law suit with the West India Co., and the large amount recovered showed how important it was that their agreement with that company should be respected. The difference of agreement between the two companies having now been finally settled, he was happy to say that both were now working in harmony, and for the joint interests. The expenses for the half-year showed an increase of £765 over those of the corresponding period, but naturally the larger traffic dealt with had led to an increase of station expenses. Altogether the expenses for the half-year had amounted to £6,099. As regarded dealing with the available balance, he might mention that the policy of the board had always been to carefully strengthen the reserve fund, while paying a correspondingly good dividend. Owing to the bad state of business and to competition, they had only been able to pay 4 per cent. during the last two years, leaving nothing for reserve after paying all expenses—in fact, last year they had to take £3,000 from the reserve to meet the cost of cable repairs. This year they were in a very fortunate position. They had been able to add £16,000 to the reserve fund without drawing upon the actual earnings of the half-year. They were also able, after providing for the preference dividend, to propose a dividend on the ordinary shares at the rate of 5 per cent. per annum, and a bonus of 4s. per share, both free of income tax, and to carry forward £6,477, as compared with £4,532 brought forward from last account. The bonus practically made up the dividend of 4 per cent. paid during the last two years to 5 per cent., and he hoped they might be able to at least continue it on the same basis. The prospects of the business at present were certainly better than they had been for some considerable time. Business generally in the West Indies seemed to be improving. Cuba also had settled down remarkably well under the new government, and its financial condition was showing signs of improvement. They had doubtless read a lot in the newspapers about what wireless telegraphy was going to do, but so far little had really been done to show that it had reached that state of development which would make it capable of competing with cable telegraph companies, and so far he did not think that shareholders in cable companies need feel any alarm. Their claim for the damage done to their cables during the Spanish-American war had not yet been paid. It was most disappointing that the American House of Representatives should not have passed it after it had been agreed to by the Senate. The Foreign Office would continue to use its influence with the American Government to bring the matter before Congress when it next met. They had made application to the new Government of Cuba for payment of the subsidy of £2,000 per annum in respect of the coast cables, which was now four years in arrear, and he was pleased to say that the matter was receiving the support of His Majesty's minister at Havana.

Mr. R. K. Gray seconded the motion, and the report was adopted.

Indo-European Telegraph Co.

The 36th ordinary general meeting of the shareholders of the above company was held on Wednesday, April 29th, at 18, Old Broad Street, Mr. J. H. Tritton presiding.

The Chairman, in proposing the adoption of the report, said that at the meeting last year he informed the shareholders that the reduction of the rate to India had been brought into force in March, and he took the opportunity of reminding them that the reduction would in all probability bring about a decrease in the company's revenue. They had, of course, noticed that the revenue this year was less by £18,735 than it was in the year 1901. There had been an increase in the traffic, but not sufficient to compensate the company for the very large reduction that was made. They hoped in future years to see that loss further reduced, and the revival in the trade with India might bring about the desired effect. The Telegraph Conference would be opened in London on May 26th, as announced in the report. It would be a pleasure to the company to see the foreign delegates in this country, and to return the courtesies and hospitalities that had always been shown to English delegates abroad. They had introduced a social code for the benefit of the general public who had relatives and friends abroad. As they were, perhaps, aware the introduction of the social code originated with the Eastern Telegraph Co., and by their courtesy they had adapted their code to their company's system. The merchant had always benefited by the elaborate codes that had been compiled to suit his purposes, and the general public were now able to avail themselves of the same privilege. The report referred to negotiations with the General Post Office for the extension of the

company's arrangement in respect of cable and special land wires rented from the Government. The present arrangement was terminable at the end of 1904, but they hoped shortly to come to an understanding with the Post Office for its extension. The directors proposed forming a reserve fund for the equalisation of dividends. There seemed to be a certain amount of nervousness on the part of investors in telegraph securities from one cause and another, and he thought it would give a feeling of greater security for the future if such a fund were formed. Foreign Governments were taking more energetic measures to form independent routes to their own colonies and dependencies, and it was only natural that the English-speaking race could not expect a monopoly in cable enterprise. It was proposed to set aside £5,000 towards a retirement fund. Many of the staff had served the company faithfully for 25 to 30 years and more, and he felt sure they would not wish the management to discharge these old servants without assisting them during the remaining years allotted to them. Turning to the condition and working of the line, the company always endeavoured to move with the times, and the Wheatstone system, introduced some years ago on the section Odessa-Teheran, and at a later date between Emden and Teheran had now been adopted over the whole line, and messages handed in in London were sent direct to Teheran and *vice versâ*. When they considered that the distance between London and Teheran was over 3,700 miles, that part of that distance consisted of submarine cable, and that the line passed through mountainous country and dense forest, they would agree with him that that was no mean record. To give an instance of a good day's working:—On April 2nd the company transmitted 560 Indian and trans-Indian messages consisting of 6,358 words, and the average delay for the day for the transmission of the messages from London to Teheran, and *vice-versâ*, was 14·52 minutes. That included the time when the message was handed over the counter in London to the time it was transferred to the Indo-European Government Telegraph Office in Teheran. The average delay for the month of March on all classes of traffic was 23·93 minutes. The delay had been considerably reduced by the more rapid Wheatstone working, in spite of the fact that the traffic had largely increased, and errors had also been reduced by that method of working, which dispensed with re-transmissions. The report showed a decrease of revenue as compared with last year of £18,735, and as already explained, that is mainly due to the reduction of the rate to India. The expenditure showed a small increase, due to non-recurrent expenses, and could not be looked upon as unsatisfactory, seeing that they had to deal with a somewhat larger traffic. The dividend and bonus absorbed £31,875. The directors proposed setting aside £5,000 towards the retirement fund, and £15 000 to form a fund for the equalisation of dividends. That leaves £17,207, which they proposed carrying forward to the credit of 1903.

Mr. W. S. Andrews, seconded the motion, and the report was adopted.

Angus Electric Light and Power Co.

The annual general meeting was held on 29th ult. at the Electricity Works, Montrose. The report showed that satisfactory progress had been made during the year. The lamp connections in Montrose had been increased from 2,066 to 6,422, equivalent to 8 c.p. lamps, and in Brechin from 2,790 to 5,725, and up to the present time 2,000 additional lamps had been applied for in Montrose and 1,200 in Brechin, making a total of 15,347 in the two towns. The result of the year's working, including £42 4s. 5½d. brought forward from last year, showed a net profit of £640 17s. 3d. At Montrose, 87,924 units were generated, and at Brechin 87,589, and the total sold was 61,102 at Montrose and 58,404 at Brechin. At Montrose there were 20 arcs and 137 incandescents for public lighting, and at Brechin 3 Nernst and 101 incandescents. In Montrose, 16-c.p. incandescent lamps cost £1 per 1,000 hours, and arcs £10 for the same period.

The Chairman of the Directors, Dr. Stone, in moving the adoption of the report, said the estimate for both towns up to the end of the financial year was equivalent to 5,400 c.p. lamps, and the actual installation was 7,291, which left a balance in excess of the estimate of 1,891. As a motive power, electricity was progressing very satisfactorily. For lighting, consumers were fully realising that, with economical management, their bills were not greater, but, in many cases, less than their gas bills were, and its advantages in respect of health and preservation in houses were being more widely appreciated.

The report was adopted.

City of Birmingham Tramways Co.

Mr. E. Garcke presided at the annual meeting of this company, held at Birmingham on April 30th. A complete account of the company's negotiations with the Corporation had been circulated among the shareholders, giving details of the company's proposals and the latest developments in connection therewith. The matter has been referred to on several occasions in our "Traction Notes," the latest move being in the direction of municipal action. The negotiations and their result, so far, occupied the greater part of Mr. Garcke's speech to the shareholders last week. He showed that if the municipality persisted in its present proposal there would be numerous interruptions in the tramway communications in view of the large number of lines which this company and other local authorities were working outside the city. He remarked that if the company failed to get an extension of its existing leases, it would be because the forces in favour of the direct employment of labour were overwhelming. The report was adopted.

Elmore's German and Austro-Hungarian Metal Co.

The directors' report for the year ending December 31st, 1902, states:—

With regard to this company it will be noted that the debenture stock has increased from £75,000 to £82,696 10s., the whole of which is now redeemable at par, the premium, amounting to £2,199 19s. 6d., having been paid. The gross profit made by the Metall Co. is greater than that made in any previous year. This is owing to the larger business done, and had it not been for the debit balance which had to be written off, the net profit made would have been M. 131,534 (£6,576 14s.). This is not so satisfactory as could be wished, but there have been increases under the heading of general expenses, depreciation and interest. It is, however, important to know that of the copper stock in hand, no less than 580 tons were taken at the price ruling on December 31st, 1901. This course places the copper stock on a safe basis, as its value is about £6,500 higher to-day than the price at which it stands in the balance-sheet. The trade in Germany is still bad, and competition is keener, but, notwithstanding, the amount sold is larger than in any previous year. The Elmore process is especially adapted for the manufacture of large diameter tubes, and for the coating of iron rollers, and if the demand for this class of work increases in the future as it has done in the past, it will be necessary before long to increase the plant. In anticipation of such a result, the managing director and the works manager visited the United States recently for the purpose of inspecting a new process for the manufacture of small diameter tubes. A machine was seen at work in several large mills which was producing quickly, efficiently and cheaply. The board has ordered a similar machine, and it is anticipated it will be at work within six months. The Exhibition at Dusseldorf was a great success, and it was eminently satisfactory that our exhibit should be awarded not only the gold medal of the Exhibition, but the great gold State medal in addition. The directors cannot refrain from drawing attention to the fact that the sum of nearly £8,000 was paid in interest last year, and remind the shareholders that debenture interest absorbs £6,600 before anything is available for the shareholders; but, notwithstanding this, and the fact that no less than nearly £3,000 was charged to revenue for depreciation, had it not been for the debit balance brought forward there would have been a dividend for the preference holders. The directors have waived one-fourth of their fees for the past year.

Dover Electricity Supply Co.

The directors' report for the year ended December 31st, 1902, reads:—

The company's business has made satisfactory progress during the year, and the supply of current for lighting, power and traction, has been well maintained. The equivalent of about 8,400 8-c.p. lamps have been added to the company's mains, the total connections now amounting to the equivalent of about 23 700 8-c.p. lamps. The output during the year to private consumers was 497,821 Board of Trade units, being an increase of 93,951 units over the previous year. The capital expenditure for the year amounts to £5,678, chiefly on account of new mains and extensions. A large new power cable has been laid to the Admiralty Pier for the purpose of supplying current to the electric cranes being erected there, and arrangements have been made with the Dover Harbour Board which ensure a profitable return for this outlay, besides which it is anticipated that several large customers for power will be obtained along the route of this main. The year's profits for which the Dover Corporation will be entitled to take credit on the completion of their purchase amount to £5,723 7s. 7d. In consequence, however, of some special deductions and reserves which the directors think it proper to provide, chiefly in respect of allowances and bad debts arising out of previous years' workings, the profit available for distribution by the company is £5,022 19s. 4d. This profit would have been larger but for the fact that the price of current was reduced by 1d. per unit from January 1st, 1902. After providing for the debenture interest, the directors recommend the payment of the full dividend of 5 per cent. on the preference shares requiring £1,250, and a dividend of 6 per cent. on the ordinary shares amounting to £3,000, leaving a balance to carry forward of £170 10s. 10d.

West Coast of America Telegraph Co.

Sir J. Denison Pender presided at the meeting of this company, held at Electra House, E.C., on Tuesday. In moving the adoption of the report, which appeared in our issue of May 1st, he showed that the company had continued to make progress during 1902. The revenue for the past five years had been as follows:—1898, £25,000; 1899, £28,000; 1900, £30,000; 1901, £32,000; and last year, 1902, £34,000. There was a net increase of £2,188 in revenue as compared with 1901. The expenses were about £23,000 in 1901, and about £24,000 in 1902, the actual increase being £1,272. After referring briefly to a few of the items, the speaker gave particulars of the year's cable interruptions. The Molendo—Rica cable failed on May 5th, and was repaired on May 13th. The Antofagasta—Serena cable failed on June 8th, and was repaired on June 13th; the cause of the break was chemical action. This cable again failed on November 11th, and was repaired on November 22nd, this break being due to the cable chafing on a rocky bottom. The Serena—Valparaiso cable broke on December 3rd, and was repaired on December 15th; it was found to be broken in two places, the cause being an earthquake. All of these items showed that the repairs had been expeditiously carried out. Including the amount brought forward, they had to deal with £10,371. Debenture interest absorbed £6,000, and bonds interest £800, leaving £3,571. Of this, £2,000 had been placed to general reserve, £1,000 to ship's reserve, £571 being carried forward to 1903. The cables were getting old, and the ship also, so their best policy was to put that £3,571 into reserve, as they had done, especially as their stock of cable out abroad for renewing was small.

The report was adopted, and the retiring directors and auditors were re-elected.

Babcock & Wilcox, Ltd.

Mr. J. Dewrance presided at the annual meeting held on April 28th at Cannon Street Hotel, when the report, as mentioned in our issue of April 24th, was adopted.

In reply to a question, the Chairman observed that the item of debtors, £428,235, was less in proportion than it was last year. Although the amount was large, he did not think that it was at all unreasonable, having regard to the company's large business. Their debtors were mostly corporations and firms who were thoroughly sound.

Prospectuses.

The British Insulated & Helsby Cables, Ltd., is offering for public subscription at par £250,000—4½ per cent. first mortgage debentures, and 18,915—£5 ordinary shares in the Midland Electric Corporation for Power Distribution. 21,085 ordinary shares have been already issued. The list is to close to-day (Friday). So far as the objects of the company are concerned and the power station at Ocker Hill, these were very fully described in the Electrical Review special "Power" issue, September 12th, 1902, and a fully illustrated reprint of that article is being circulated with the prospectus. Mr. J. Hardie McLean in a report to the board, dated April 23rd, 1903, says that the company is already supplying power to 17 miles of tramways, and the immediate demand for lighting purposes may be taken as the equivalent of 60,000 8-c.p. lamps, the factory power demand requiring another 2,500 kw. Within the next two or three years, according to his estimate, the demand will be about 13 millions of units per annum. We fail to notice, however, any report from the engineers who designed and carried out the installation.

The directors of the Yorkshire Electric Tramways Syndicate, Ltd., which has a capital of £280,000, divided into 180 preference shares of £1,000 each and 10,000 ordinary shares of £10 each, has this week been inviting subscriptions for the whole of the preference shares. The prospectus states that the syndicate has been formed to acquire four provisional orders, and to construct certain authorised electric tramways in the Leeds, Wakefield and West Riding districts, &c., the proposed length of route being about 55 miles. Messrs. Dick, Kerr & Co., Ltd., are stated to have entered into a contract to construct and equip the lines. The list was to close on Tuesday.

The list opens on May 11th, and closes on May 12th, in an issue of 37,500 preference and 37,500 ordinary shares, all of £1 each, in the Craigpark Electric Cable Co. The manufacture of electric and telegraph wires and cables, and gutta-percha and rubber goods has been carried on since 1897 by the Craigpark Co., Ltd., at Townmill Road, Glasgow, and the profits have allowed of dividends on the ordinary shares for the five years as follows:—4 per cent., 8 per cent., 10 per cent., 12½ per cent., 12½ per cent. The vendors—the Craigpark Co.—will transfer the business for £37,500 payable in cash, this figure including £4,239 for goodwill. The nominal capital of the new company is £150,000, and it has been formed to meet the increasing business. The directors are Messrs. J. T. Tullis (chairman); W. S. Brown, W. R. Dick, Claud Hamilton, and Andrew B. Maclean (managing director). Lord Kelvin is consulting engineer to the company. The offices are at Flemington Street, Springburn, Glasgow, and the secretary is Mr. John Deas.

Stock Exchange Notices.—The Committee has ordered the undermentioned securities to be quoted in the Official List:—Commercial Cable Co.—$1,666,700 additional capital stock. Edmundson's Electricity Corporation, Ltd.—Further issue of 20,000 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 30,001 to 50,000. Waygood & Otis, Ltd.—Further issue of 30,000 ordinary shares of £1 each, fully paid, Nos. 105,001 to 135,000; and 30,000 6 per cent. cumulative preference shares of £1 each, fully paid, Nos. 105,001 to 135,000. The Committee has further been asked to allow the following to be quoted in the Official List:—Edmundson's Electricity Corporation, Ltd.—Further issue of £60,000 4½ per cent. first mortgage debenture stock (redeemable). Urban Electric Supply Co., Ltd.—4,000 ordinary shares of £5 each, fully paid.

Meldrum Bros., Ltd.—On April 30th the annual meeting of this company was held at the registered offices, Timperley, near Manchester. After passing the usual dividend of 5½ per cent. on the preference shares and allowing £1,000 off goodwill and patents, there was a sufficient sum available to pay 8 per cent. dividend on the ordinary shares, and to carry forward the sum of £2,542. After the meeting, a special meeting of preference shareholders was held to sanction the issue of an additional 25 000 cumulative preference shares ranking *pari passu* with the existing preference shares. The resolution was unanimously agreed to. After the meeting the shareholders inspected the new works, and expressed great satisfaction with the completeness of all the arrangements and appliances.

Submarine Cables Trust.—The Marquis of Tweeddale presided at the meeting held at Electra House on Tuesday. He moved the adoption of the report, which has already been abstracted in our columns, and said that the revenue was practically the same as that of the previous year. He thought that, on the whole, the result of the year's working would be regarded as satisfactory. The report was adopted.

British Westinghouse Electric and Manufacturing Co.—The transfer books will be closed from May 5th to 15th for the preparation of warrants for the interim dividend on the 6 per cent. preference shares for the six months ending January 31st last.

British Electric Traction Co.—A financial daily reports that in response to the request of numerous shareholders of the Brush Electrical Engineering Co., the British Electric Traction Co. has agreed to extend the time for the acceptance of its offer to exchange shares until the 16th inst.

Globe Telegraph and Trust Co.—A final dividend is announced of 2s. 6d. per share on the ordinary shares, carrying forward about £3,000.

STOCKS AND SHARES.

Wednesday Evening.

The Transvaal Loan is the one chief and absorbing topic of interest in the stock markets, and now that the long-expected is at last happening, general business should become better in all departments which the shadow of this guaranteed issue was supposed to have been darkening. All sections of the financial community agree in rejoicing that the loan should at length become an accomplished fact. Money has undoubtedly been restrained from ordinary investment channels in order to be at the call of all classes of capitalists so soon as the Transvaal prospectus appeared. Once the allotments are out and capital settles down into more normal conditions, it is hoped by the Stock Exchange that a fresh impetus will be diverted to investments all round the House, in which such solid securities as are most of those we deal with should, of course, share in their proper proportion.

Publication of the important and far-reaching scheme whereby the Yerkes group would be knit into one largely capitalised whole, has, so far, had very little effect upon any of the securities involved. Of course, the matter cannot make much progress while the Royal Commission on London's traffic problem is continuing its deliberations. District Ordinary stock at 41, and London United Tramways Preference at 12, are much the same as they were last week, although it may be noticed that Metropolitan Railway stock has climbed to 91, so that proprietors in the Metropolitan are, so far, having no cause for regret at their directors' refusal to enter into a still closer union with the Americanised group. Mersey Railway Consolidated stock sticks at 14, the inauguration of the new electric train service producing no effect upon the price. British Westinghouse Preference, however, are better at 6¼ on the practical completion of this company's contract with the Mersey Railway. The new Preference shares are 6 middle, and the Debenture stock changed hands the other day at 103½, some five points above the price at which it stood when we suggested the investment as a desirably cheap one.

None of the purely electrical railway stocks have appreciably moved during the week, Great Northern and City Preferred "A" shares at 8½ being *ex* the dividend of 31, while Great Northern, Piccadilly and Brompton Ordinary are 10, the opening of the Royal Academy being laughingly disregarded as a bull point in the company's present circumstances. City and South London Ordinary stock is 1 down at 73, and it is thought that the opening of the electrical working of the L.C.C. tramways from Tooting to Westminster may possibly affect the railway company to a small extent. The Prince of Wales performs the opening ceremony next week. It is stated that Manchester again has a Twopenny Tube under consideration.

Electrical Supply descriptions are very quiet so far as quotable changes go. There is still a steady investment business doing in the principal shares, but scarcely one of them altered on the week. Edmundson's Preference are *ex* a 3s. dividend, and no change has been made. Metropolitans recovered the small loss shown a week ago, and the general tone remains firm. Charing Cross Debenture stock has risen a point; Bournemouth and Poole Preference are being dealt in at about 10½. Primitiva Gas and Electric Lighting, of Buenos Ayres, Ordinary shares are the latest to be revived by the optimism now abundantly current in regard to the Silver Republic, and have risen to ⅞ *ex* the dividend recently declared. The 5 per cent. cumulative Preference shares stand at 4½, and the 4 per cent. First Debentures at 94.

New prospectuses call for some little comment. The Yorkshire Electric Tramways Construction Syndicate, with its 180 £1,000 shares is *caviare* to the average investor, and of a type very different from the undertaking called J. Bakewell & Co., a concern which perhaps our country readers have reason to know mostly, as the prospectus does not appear to be widely circulating in London. The company's head office, however, is stated to be in the metropolis, although it has branches of its electrical business at Peterborough and Southend. The prospectus should be left severely alone. An offer by the British Insulated and Helsby Cables, Ltd., of debentures and ordinary shares in the Midland Electric Corporation is being made, and the securities look a fair commercial risk, although there are many other better investments to be had. The shares in the parent company are dull at 7¼.

A line of dividend deductions is answerable for the chief changes that are to be seen in the Telegraph section. There is a hardening tendency in the Eastern group, which should prove very acceptable to the sorely-tried stockholders after the way in which their properties have been damaged by the Marconi scare. Indo-European shares have advanced 17s. 6d., allowing for the deduction, but Great Northern are fractionally lower. Several of the telephone varieties display slight improvement. United River Plates are 6 middle, and Orientals at 1 are the dividend of 8½d. to the good. Monte Video Telephones have not moved with the Argentine concerns, and the National Telephone septet is unchanged. The time for exchanging Brush shares into British Electric Tractions has been extended to May 16th, next Saturday week.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations April 29th.	Closing Quotations May 6th.	Business done week ended May 6th, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	97 —101	97 —101	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2⅛— 3⅛	2⅛— 3⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3½%	61s.	60/6	48 — 51	48 — 51	..	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	89 — 91	89 — 91	90½	89
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	9⅜— 9½	8¾— 9⅛	8¼	8⅛
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	..	4½— 5	4½— 5⅛	4⅝	..
13,333,300$	Commercial Cable	$100	8 %	8 %	..	155 —155	155 —165	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	89 — 92	89 — 92	90½	89⅞
16,000	Cuba Telegraph	10	4½%	4 %	6½%	7 — 8	6½— 7⅞	7	..
6,000	Do. 10 % Pref.	10	..	..	..	15 — 16	14½— 15½	..	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2⅝— 3⅛	2⅝— 3⅛	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
90,000	Do. do. 4½ % Debs.	20	..	..	..	.. — ..	99 —102	102	..
60,710£	Direct United States Cable	20	3½%	3½%	..	9 — 10	9 — 10	9⅞	9½
92,800£	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —102	99 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	116 —121	117 —122	120	118½
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	83 — 86	83 — 86	85½	83½
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —109	104 —107	105½	104
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	11 — 12	11 — 12	11⅜	11
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	105 —108	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	101 —104 %	101 —104 %	102	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	..	8½— 9	8¾— 9	8⅝	8⅜
180,042	Do. do. 6 % Pref.	10	..	..	..	12 — 13	12 — 13	12½	12
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	21 — 26	23 — 25	..	..
66,800£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	37 — 41	36 — 40	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	100 —104	100 —104	..	..
72,680	Montevideo Telephone, Ltd., Ord. Nos. 1 to 72,680	1	2½%	2½%	..	⅛— ¼	⅛— ¼	..	..
86,492	Do. do. 5 % Pref., Nos. 1 to 86,492	1	..	..	..	½— 1	½— 1	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	99 —101	99 —101	100⅛	99⅞
1,966,667	Do. do. Def. Stock	100	..	..	4½%	77 — 79	77 — 79	78⅛	78
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	..	..
250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5⅛	..
2,000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 — 99	97 — 99	99	98
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	102 —104	102 —104	102	..
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	⅛— 1⅛	⅛— 1⅛	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,839	Reuter's	8	5 %	5 %	..	6½— 7⅛	6½— 7⅛	..	..
3,308	Submarine Cables Trust	Cert.	..	..	..	102 —112	102 —112 xd	107	106
58,000	United River Plate Telephone	5	7 %	7 %	..	5½— 6	5⅞— 6⅛	5⅞	5⅞
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅞— 5⅛	4⅞— 5⅛	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	105 —108	105 —108	..	..
15,609	West African Telegraph, Shares	10	..	..	..	3 — 4	3 — 4	..	..
30,008	West Coast of America, Nos. 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	0 — ¼	0 — ¼	..	..
150,000£	Do. do. 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	96 — 99	92 — 97	92	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	..	11 — 12	11 — 12	11⅞	11
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —104	101 —104	103	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	96 — 99	96 — 99	..	..
88,321	West India and Panama Telegraph	10	½%	..	..	⅛— ⅜	⅛— ⅜	⅜	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6½— 6¾	6½— 6¾	6⅝	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3½— 4	3½— 4½	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	99 —102	99 —102	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	75 — 80	73 — 78 xd	..	..
100,000	British Electric Traction	10	9 %	9 %	..	13⅜— 14⅛	13⅜— 14⅛	14⅛	13⅝
100,000	Do. do. Cum. Pref.	10	..	..	..	12 — 12⅝	12 — 12⅝	12⅝	12⅜
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	122 —125	122 —125	..	..
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	7⅛— 8	8 — 8⅛ xd	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅞— 6⅛	5⅞— 6⅛	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	103 —107	103 —107	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	⅜— ½	⅜— ½	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	16s. to 17s.	16s. to 17s.	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	¾— 1⅛	1 — 1⅛	1	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1⅛— 1⅜	1⅛— 1⅜	1⅛	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	89 — 94	89 — 94	90½	..
35,000	Callender's Cable Construction shares	5	15 %	20 %	..	13 — 14	13 — 14	13	11⅞
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5¾— 6	5⅞— 6	5⅞	5¾
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	108 —112	108 —112	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	106 —109	106 —109	108	107
494,098	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	103 —106	103 —106	105⅛	103½
494,998	Do. do. Def. do.	Stock	..	4 %	4 %	109 —112	109 —112	110½	..
1,330,000	City and South London Railway	Stock	1½%	2 %	3½%	75 — 75	73 — 75	74	73
85,000	Crompton & Co., Nos. 1 to 85,000	3	8 %	7½%	..	2¼— 2⅜	2¼— 2⅜	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	10 —106	102 —106	..	..
	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	0 — ¼	0 — ¼	..	..
17,139	Do. do. 'A" shares, 01—017,139	5	2½%	Nil	..	1⅛— ⅜	1⅛— 2⅜	..	..
344,023£	Do. do. % Deb. Stock Red.	100	..	..	..	73 — 7	73 — 77	..	..
100,000	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	75 — 8	75 — 80	..	..
112,100	Electric Construction, to 112,100	2	6 %	6 %	..	1⅜— 1⅝	1⅜— 1⅝	1⅜	1⅜
81,300	Do. % Cum. Pref. 1 to 81,300	2	..	..	..	2⅛— 2⅜	2⅛— 2⅜	..	..
82,530	Do. % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	— —	100 —110	..	..
25,000	General Electric Co. [illegible]	[illegible]	..	..	..	— —	10 — 11	..	..
200,000	[illegible]	£ stock	..	..	..	— —	11 — 12	..	..
85,000	Henley's (W. T.) Telegraph Work[illegible]	1	—	—	..	— —	— —	—	..
85,000	Do. do. 4½ % Pref.	..	..	..	..	— —	— —	—	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	— —	— —	—	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	— —	— —	—	..
300,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —	— —	—	..
87,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	5⅛— 5⅛	— —	—	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10⅛— 1⅛	— —	—	..
7,500	Parker (Thomas), Ltd., Ord., Nos. 1 to 7,500	10	..	..	..	14⅛— 5⅛	— —	—	..
37,350	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	81 — 7	— —	92	86
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	[illegible] — —	— —	—	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	5 %	..	8 —	— —	—	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 1/—2/.
National Electric Free Wiring, 14/—16/.

Oldham, Ashton and Hyde Electric (£10 pd.), Ord., 14½—14⅝.
Do. do. Pref. (£10 pd.), 10—10½.

Bank rate of discount 4 per cent. (October 2nd, 1902)

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Shares.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations April 29th.	Closing Quotations May 6th.	Business done week ended May 6th, 1903. Highest.	Lowest.
		‡							
100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	1	..	..	..	⅜ — ⅝	⅜ — ⅝	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	..	..	..	118 —121	118 —121	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000	5	6 %	8 %	8 %	10½— 11	10½— 11	..	..
20,000	Do. do. 7 % Cum. Pref.	5	..	..	..	10½— 10⅝	10½— 10⅝	..	..
80,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9 — 9⅛	9 — 9⅛	9⅛	9⅛
70,000	Do. do. do. 4½% Cum. Pref.	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	5⅜	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref.	5	..	..	..	4⅞— 5⅛	4⅞— 5⅛	5	4⅞
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	105 —107	105 —107	..	..
44,436	*Chelsea Electricity Supply, Ord.	5	5½%	4 %	4½%	6 — 6⅛	6 — 6⅛	..	..
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	109 —112	109 —112	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 %	5 %	5 %	10⅜— 11⅛	11 — 11⅛	11⅛	10⅜
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13⅛— 14⅛	13⅛— 14⅛	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	122 —127	122 —127	..	..
200,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	103 —106	103 —106	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4 %	8 — 9	8 — 9	..	..
20,000	Do. do. 6 % Pref., 40,001—60,000	10	..	..	..	12 — 13	12 — 13	12⅛	..
400,000‡	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red	..	..	..	..	110 —113	110 —113	111½	111½
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	6⅞— 7⅛	6⅞— 7⅛	..	..
80,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6⅞— 6⅞	6⅞— 6⅞ xd	..	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock	100	..	..	..	107 —110	107 —110	109	109½
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	10 — 11	11 — 12	11⅛	..
90,000	Do. do. do. 4 % Debenture Stock	Stock	..	..	..	100 —103	100 —103	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	2½— 2⅝	2½— 2⅝	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5⅝— 6	5⅝— 6	..	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	100 —103	100 —103	101	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6½%	7½%	17 — 18	17⅛— 18½	17⅛	17⅛
250,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	110 —115	110 —115	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	98 —101	98 —101	99	..
10,882	Notting Hill Electric Lighting	10	7 %	6 %	6 %	14 — 15	14 — 15	14⅛	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15⅛— 16⅛	15⅛— 16⅛	..	..
20,000	Do. do. do. 7 % Pref. 20,001 to 40,000	5	..	..	..	8⅝— 9⅛	8⅝— 9⅛	9⅛	..
150,000‡	Do. do. do. 3½% Deb. Stock Red	100	..	..	..	98 —101	98 —101	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	3 — 3⅛	3 — 3⅛	..	..
80,000‡	Do. do. 4% Deb.	100	..	..	..	88 — 93	88 — 93	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	12½%	3¾— 4	3¾— 4	..	..
90,000	Urban Electric Supply, Ord.	5	..	..	..	4⅜— 5⅛	4⅜— 5⅛	5⅛	5
20,000	Do. do. 5 % Cum. Pref.	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	5⅜	5
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12 — 13	12 — 13	12⅛	12⅛
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6½— 7	6½— 6¾	..	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, May 6th.

CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£13	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£21 15	..
a Lead, Nitrate	per ton	£24	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks	per lb.	3d.	..
a ,, Caustic (75/80%)	per ton	£24	..
a ,, Bisulphate	per ton	£35	..
a Shellac	per cwt.	121/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 5	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a ,, Crystals	per ton	£3	..
a ,, Bichromate, casks	per lb.	2½d.	..

METALS, &c.		Latest Price.	Week's Inc. or Dec.
b Aluminium Ingots, in ton lots	per ton	£190	..
b ,, Wire, in ton lots	per ton	£168	..
b ,, Sheet, in ton lots	per ton	£166	..
p Babbitt's metal ingots	per ton	£43 to £145	..
c Brass (rolled metal 7" to 12") basis	per lb.	7d.	½d. dec.
c ,, Tube (brazed)	per lb.	9½d.	..
c ,, ,, (solid drawn)	per lb.	7¾d.	..
c ,, Wire, basis	per lb.	7¼d.	½d. dec.
c Copper Tubes (brazed)	per lb.	9¾d.	..
c ,, ,, (solid drawn)	per lb.	9¾d.	..
g Copper Bars (best selected	per ton	£75	..

METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec.
g Copper Sheet	per ton	£75	..
g ,, Rod	per ton	£75	..
e ,, (Electrolytic) Bars	per ton	£72	..
e ,, ,, Sheets	per ton	£83	..
e ,, ,, Rod	per ton	£78 10	..
e ,, ,, H.C. Wire	per lb.	8¾d.	..
f Ebonite Rod	per lb.	3/-	..
f ,, Sheet	per lb.	5/-	..
m German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	3/10½ to 3/11½	inc.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	46/3	4½d. dec.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	..
g Lead, English Ingot	per ton	£12 7 6	2/6 inc.
g ,, ,, Sheet	per ton	£14 10	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£8 12 6	..
d Mica (in original cases) small	per lb.	3d. to 1s.	..
d ,, ,, medium	per lb.	2s. to 3/8	..
d ,, ,, large	per lb.	3/6 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	..
o Platinum	per oz.	£4	..
p Silicium Bronze Wire	per lb.	10d. to 1/-	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars	per ton	£15 to £40	..
g Tin, Block	per ton	£137 to £138	30s. dec.
g ,, Foil	per lb.	1/6½	..
n ,, Wire, Nos. 1 to 16	per lb.	1/9	..
p White Anti-friction Metals—			
"White Ant" brand	per ton	£42 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7¾d.	..
j ,, 6 lea. Flax	per lb.	5¾d.	..
j ,, 3 ply 10 lbs. Russian	per lb.	4¼d.	..
j ,, 10 lbs. Russian, single	per lb.	4¼d.	..
j ,, 180 lbs. Jute rove	per ton	£11	..
k Zinc, Sh't (Vieille Montagne brd.)	per ton	£26 15	..

Quotations supplied by:—a Messrs. G. Boor & Co.; b The British Aluminium Co., Ltd.; c Messrs. Thos. Bolton & Sons., Ltd.; d Messrs. F. Wiggins & Sons.; e Messrs. Frederick Smith & Co.; f India-Rubber, G.P. and Teleg. Works Co., Ltd.; g Messrs. James & Shakespeare; h Messrs. Edward Tuil & Co.; i Messrs. Bolling and Lowe; j Messrs. W. H. Hindley & Co.; k Messrs. Morris Ashby, Ltd.; m Messrs. W. T. Glover & Co., Ltd.; n Messrs. P. Ormiston & Sons; o Messrs. Johnson, Matthey & Co., Ltd.; p The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

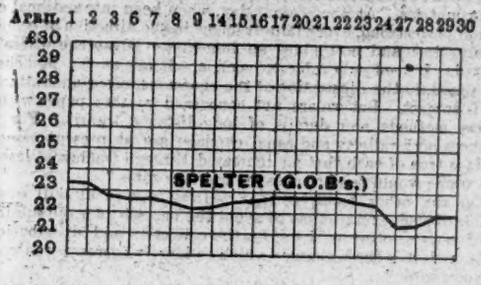
Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
Aberdeen	May 2	908	+224	45,879	+11,502	—	—
Birmingham	,, 2	5,123	+288	88,825	+ 4,966	—	—
Bournemouth	Apr. 29	975	—	4,295	—	—	—
Blackburn	,, 24	+06	+ 26	2,843	+ 824	12½	+1½
Blackpool and Fleetwood	May 2	206	— 54	4,616	+ 870	7½	—
Bolton	,, 2	1,662	+126	8,906	+ 1,646	25	—
Bradford	Apr. 25	4,837	+20	13,944	+ 1,198	39	+2
Bristol	May 1	4,537	+269	—	—	28	—
Burnley	,, 2	726	+ 29	—	—	—	—
British Elec. Trac. Co.:—							
Barnsley District	Apr. 24	151	—	2,721	—	—	—
Devonport	,, 24	114	+ 16	6,514	+ 177	5	—
Dudley—Stourbridge	,, 24	703	+ 20	11,906	+ 1,170	18½	—
Gateshead	,, 24	734	+ 63	13,392	+ 2,860	10½	+ ½
Gravesend—Northfleet	,, 24	170	—	3,002	—	3½	—
Greenock—Pt. Glasgow	,, 24	936	+ 76	7,976	+ 656	7½	—
Hartlepool	,, 24	219	— 99	3,672	+ 474	6½	+2
Kidderminster	,, 24	106	+ 3	1,738	+ 103	4½	—
Merthyr	,, 24	179	+ 4	2,977	— 154	8	—
Middleton	,, 24	298	+ 25	4,187	+ 118	8½	—
Oldham—Ashton	,, 24	526	+ 29	6,711	+ 995	8	—
Peterborough	,, 24	124	—	1,819	—	—	—
Poole	,, 24	277	+ 17	4,078	+ 704	8½	—
Potteries	,, 24	1,475	+ 6	24,585	+ 1,965	29½	—
Rotherham	,, 24	119	+ 73	950	+ 408	—	—
Sheerness	,, 22	77	—	299	—	—	—

Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
B.E.T. Co. (*continued*)—							
Southport	Apr. 24	252	+ 23	3,907	+ 1,275	5½	—
South Staffordshire	,, 24	772	+ 7	12,027	+ 48	21½	— ½
Swansea	,, 24	449	+ 13	7,376	+ 102	5½	—
Taunton	,, 24	46	— 14	850	— 55	1½	+1½
Tynemouth	,, 24	223	+ 12	3,790	+ 468	9½	—
Weston-super-Mare	,, 24	74	—	598	—	2½	+2½
Wolverhampton Dist.	,, 24	346	+190	5,848	+ 3,353	10½	+5
Wrexham	,, 24	110	—	488	—	—	—
Yorks. Woollen Dist.	,, 24	351	—	1,855	—	6	—
Cardiff	,, 25	1,639	+255	6,597	+ 4,025	—	—
Dover	May 3	211	+ 27	3,247	+ 59	3	—
Dublin	,, 1	4,479	— 10	75,682	+ 3,878	46	—
East Ham	,, 2	977	+186	2,930	+ 1,009	5	+ ½
Glasgow	,, 2	13,180	+1494	508,567	+27,841	84	+12
Isle of Thanet	,, 2	393	— 15	5,648	— 622	—	—
Leeds	,, 2	5,111	+280	28,406	+ 2,701	—	—
Liverpool	Apr. 25	9,556	+297	159,987	+ 8,486	101	+5
Manchester	May 3	11,687	—	—	—	110	—
Newcastle	,, 2	3,074	+614	—	—	17	—
Portsmouth	,, 2	1,406	+ 88	—	—	29	—
Salford	,, 4	3,114*	+897	16,201	+ 5,946	—	—
Sunderland	,, 3	1,955	— 21	5,179	+ 124	12	—
Central London Railway	,, 2	6,805	—184	125,808	+ 6,408	6	—
City and S. London Ry.	,, 3	3 001	+ 81	56,7?9	+ 2,334	6½	+½
Liverpool Overhead Ry.	,, 3	1,8?8	+221	27,841	+ 2,600	6½	—

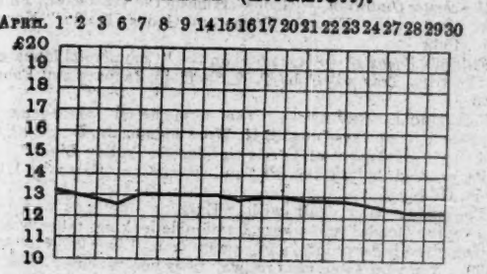
* Compared with the corresponding period of 1902.

METAL MARKET.

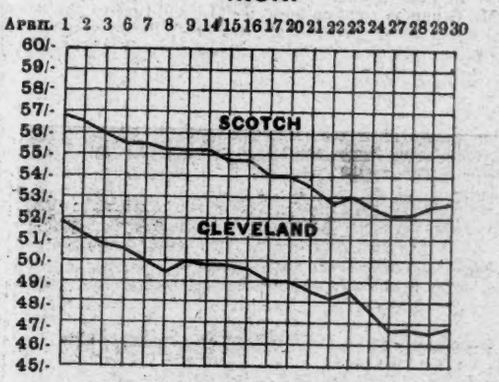
Fluctuations in April.



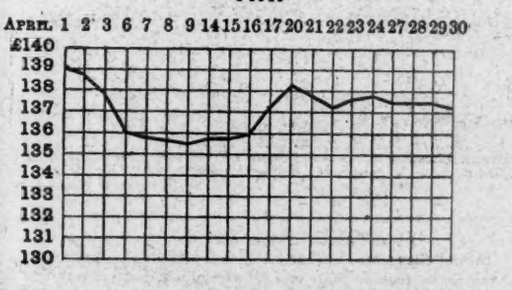
LEAD (ENGLISH).



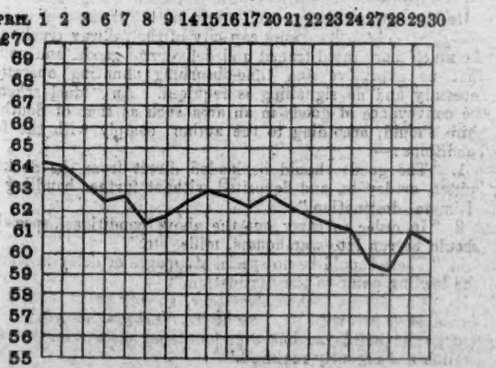
IRON.



TIN.



COPPER (G.M.B's.)



TH AFRICAN NOTES.

April 13th, 1903.

Bloemfontein, O.R.C.—The Town Council this week passed the supplementary estimates for the current year providing for various public works; amongst which are extensions to the electric lighting system, refuse destructor, &c., at a total estimated expenditure of £70,000.

Durban, Natal.—The departure of Mr. J. W. Coleman, of the Durban telegraph service, for a 12 months' furlough in England, was made the occasion for his colleagues to present him with a handsome silver punch bowl. Mr. Coleman has been connected with the Durban Post Office for nearly a quarter of a century, and at the time he joined the service, the combined telegraph and telephone staffs consisted of 11 men, whilst to-day they total 250. Mr. Frank Eastman was also presented with a silver tea and coffee service on the occasion of his departure for Pietermaritzburg, where he will continue in the telegraph service.

Harrismith, O.R.C.—Mr. Dawbarn, of Messrs. Mordey and Dawbarn, has just concluded a visit to Harrismith, where he has drawn up a scheme of electric lighting for the Corporation. The total estimated cost is £30,000, and provides for the illumination of the military cantonments on King's Hill, as well as the town. It is hoped to have the station working by this time next year.

Middleburg.—A proposal is on foot to instal an electric lighting system in the town.

Cape Town Section I.E.E.—At the fourth annual meeting held in the South African College this week the apathy of the members was deplored by the president. In fact, the advisability of discontinuing the meetings was discussed owing to the poor attendances. After some discussion it was finally decided to organise visits to the local stations, works, &c., to endeavour to stimulate some interest in the Institute and thus bring up the membership.

Johannesburg.—In the projected extensions to the existing telephone system it is proposed to introduce a cable system capable of accommodating 10,000 subscribers, extending from Wolmarans Street to the mines, and from Fordsburg boundary to Doornfontein and Jeppestown. The first instalment of the apparatus for the subterranean duct has already been indented for, from England. The work, which will take a couple of years, will be proceeded with in sections or arteries so as to gradually relieve the more congested aerial routes. Meanwhile, provision is being made to increase the existing switchboard accommodation by providing for 600 additional subscribers, and orders have been placed in Europe for the requisite apparatus, &c. Authority has been issued for the construction of over 80 new lines this week, making a total of 200 additional subscribers since September, exclusive of private wires and extensions to the existing circuits, and it is confidently anticipated that by the beginning of July no public inconvenience will be felt.

Suburban Lighting Syndicate—The Johannesburg Tramway Committee will recommend to the Town Council next week:—"That an offer be made to the Suburban Lighting Co. to take over their entire lighting undertaking, including land, buildings, plant, mains, poles street lamps and all accessories for the sum of £2,100."

Boksburg, East Rand.—A public meeting was held this week at the invitation of the Health Board, to consider the electric lighting question to which we referred some time ago (ELECTRICAL REVIEW, February 13th, 1903.) It was one of the largest meetings ever held here, and was, moreover, absolutely unanimous. The chairman, Mr. Gilfillan, the resident magistrate, in his speech, said that after much trouble they had succeeded in preparing a scheme of electric lighting for private and public convenience, which was also satisfactory to both the contractor, Mr. Gellender, and to the township. After communicating with the Colonial Secretary, they were informed that the board had no power to enter into a contract for public lighting at present, but that under the new Health Board Ordinance such provision would be made. This would mean many months' delay, unless they were prepared to accept a Government scheme, which it was estimated would cost private consumers 1s. 6d. per unit, against the 9d. per unit arranged with Mr. Gellender. The meeting was, of course, unanimously in favour of carrying out the latter's contract, and strong representation is to be made to the Government to enable the Health Board to proceed with the scheme without further delay, and there is every reason to believe that such course will be allowed.

ELECTRIC WELDING IN DYNAMO CONSTRUCTION.

THE Thomson process of electric welding has been recently applied with great success to the construction of dynamos and motors. A special automatic welding machine is used for this purpose, the general construction of which is shown in fig 1, on the next page. A welder of this type has been installed by the British Westinghouse Electric and Manufacturing Co., Ltd., at their works at Trafford Park, Manchester, especially for the purpose of welding together copper conductors, such as are used on field-magnet coils.

The welding machine is mounted on a portable trolley, and is connected to one phase of the two-phase alternating current circuit at 440 volts, 25 cycles, used for lighting and driving the works.

Plugs are fixed at several convenient points in the bay where the field magnet winding is carried on, by means of which the welder can be used at any particular spot as, and when, required.

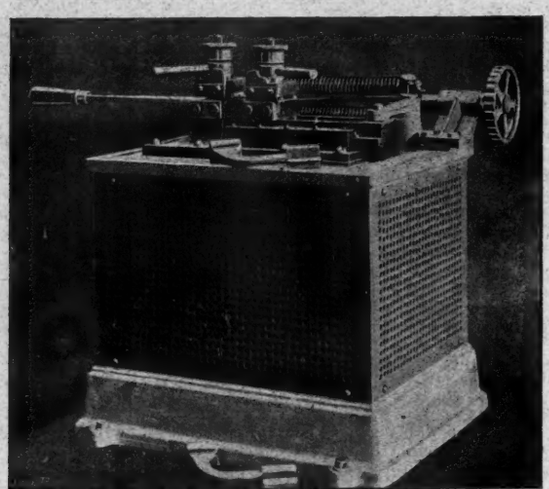


FIG. 1.

The operation of welding is exceedingly simple. The ends of the circular wire or rectangular section of copper required to be welded are cut off square, and secured in the adjustable clamps which form the ends of the secondary of the welding transformer. One clamp is stationary, while the other is capable of being moved towards the fixed clamp in the operation of welding. Adjustments for different sizes of material are made by means of distance gauges, and also by an automatic switch with marked quadrant and set screw. The movable clamp is operated by means of a strong spiral spring, provided with a graduated scale for the purpose of adjusting the pressure. The ends of the material being securely clamped as above described, the current is switched on, and the weld is instantaneously and automatically effected by the machine, quite independently of the skill of the operator. Immediately the weld is made, the automatic switch before mentioned comes into operation, cutting off the supply of current to the primary of the transformer.

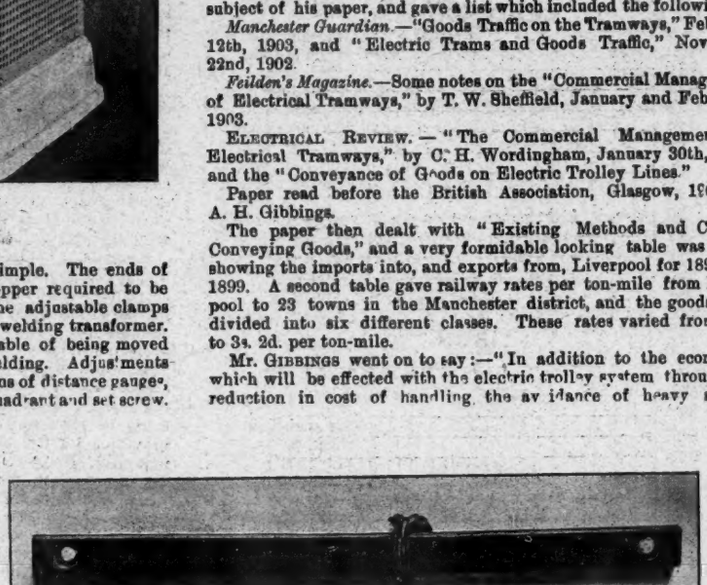
Fig. 2 illustrates some typical welds in copper made by this machine, the largest size being $\frac{5}{8}$ in. × $\frac{3}{8}$ in. The actual range of sizes dealt with in practice at the British Westinghouse Electric and Manufacturing Co.'s works is from No. 12 S.W.G. copper wire to a rectangular section copper bar $\frac{1}{4}$ in. × $\frac{3}{8}$ in.

In the illustration, the welds are shown with the burr left on, and represent in each case the state of the material exactly as it leaves the machine; the burrs are afterwards removed with a file.

List of copper samples:—

No. 1	... ...	9/16 in. × 3/8 in.
No. 2	... ...	1/4 in. × 1/4 in.
No. 3	... ...	5/16 in. × 5/16 in.
No. 4	... ...	No. 9 S.W.G
No. 5	... ...	No. 12 S.W.G.

It should be mentioned that the credit of being the pioneers in this country, in putting into operation this particular application of the Thomson electric welding system, is due to the British Westinghouse Electric and Manufacturing Co., Ltd. They had previously had considerable and satisfactory experience of the same process for this class of work in their Pittsburg works. The plant described was supplied by the Electric Welding Co., Ltd., of 28, Basinghall Street, London, E.C.



1.
3 2.
4.
5

FIG 2.

INSTITUTION OF ELECTRICAL ENGINEERS

MANCHESTER SECTION.

AT the annual general meeting of this Section, held on April 21st, Mr. H. A. Earle presiding, a paper was read by Mr. ALFRED H. GIBBINGS on "The Carriage of Goods on Electric Tramways."

A number of interesting lantern views were shown during the course of the paper. One was a map of the interconnected tramway systems of South Lancashire; it included places around Manchester as far west as Liverpool and as far north as Bolton and Accrington. Other views showed what is being done in parts of America in carrying goods on tramways.

Mr. GIBBINGS commenced his paper with the following remarks:—"The many questions involved in the carriage of goods have always been of supreme importance to manufacturing communities in all countries. At the present day, when keen international competition is so strong, every improvement in the direction of economy of both time and cost gives an immediate advantage where it is adopted. I need only refer to such a scheme as the Manchester Ship Canal, in the illustration of the enormous importance attaching to this subject. But we are not concerned in this paper with the various methods and details of long-distance transit. For long distances both railway and canal carriage are at present essential, and it is true of each that an increased through traffic and lessened local traffic would tend to cheapen existing rates."

"On the other hand, neither railway nor canal will ever be capable of such extension as to avoid the necessity for the subsidiary use of carts or other vehicles, for the collection and distribution of goods, and it is these charges which so largely increase the cost of transportation."

Further on the author referred to the literature dealing with the subject of his paper, and gave a list which included the following:—

Manchester Guardian.—"Goods Traffic on the Tramways," February 12th, 1903, and "Electric Trams and Goods Traffic," November 22nd, 1902.

Feilden's Magazine.—Some notes on the "Commercial Management of Electrical Tramways," by T. W. Sheffield, January and February, 1903.

ELECTRICAL REVIEW.—"The Commercial Management of Electrical Tramways," by C. H. Wordingham, January 30th, 1903, and the "Conveyance of Goods on Electric Trolley Lines."

Paper read before the British Association, Glasgow, 1901, by A. H. Gibbings.

The paper then dealt with "Existing Methods and Cost of Conveying Goods," and a very formidable looking table was given showing the imports into, and exports from, Liverpool for 1898 and 1899. A second table gave railway rates per ton-mile from Liverpool to 23 towns in the Manchester district, and the goods were divided into six different classes. These rates varied from 2½d. to 3s. 2d. per ton-mile.

Mr. GIBBINGS went on to say:—"In addition to the economies which will be effected with the electric trolley system through the reduction in cost of handling, the avoidance of heavy station terminal charges and other tolls, and the disappearance of carters charges at least at one end of the route, further savings may be anticipated through the higher average weight which it will be possible to deal with per car-mile, and the small capital involved ... on compared with railway rolling stock and adjuncts."

He also estimated that each truck (on the tramways) will have at least four times the earning capacity of the railway truck, owing to the much more rapid transit and delivery of goods, and pointed out that no expensive and time-absorbing shunting operations are necessary and no signalling is required. An "ideal scheme" for the conveyance of goods in an area such as that of South Lancashire should, according to the author, comply with the following conditions:—

1. "The goods should be loaded direct from the docks, warehouses, or depôts, and deposited without further handling at their ultimate destination."

2. "In order to carry out the above conditions, special sidings should be run into warehouses, mills, etc."

3. "There should be no special stoppages or delay in transit from the loading point to the destination."

4. "The service, when necessary, should be continuous for the whole 24 hours per day, excluding, perhaps, Saturdays, Sundays, and public holidays; but even on these days a service should be available if urgently required."

Following on this, some rather interesting plans and particulars were given of special trucks which have been devised to facilitate the transference of goods from trucks running on lines of one gauge to those on lines of another gauge.

Tables of "General Results of Observations of Causes of Road Wear and Deterioration," and "Cost of Generating Electrical Energy with Varying Load Factor, in Pence per Kilowatt-Hour at Dynamo Terminals; Maximum demand 2,000 KW." were also given.

Mr. Gibbings is of opinion that the noise created during the night by the carriage of heavy goods on rails would be rather less than that produced by lorries, and that, therefore, this objection to the system which he advocates is not nearly so great as some people assert.

The chief engineering and traffic difficulties are enumerated as follows:—

1. "The method of distributing goods to outlying districts, mills, warehouses, &c."

2. "The difficulty of obtaining the sanction and approval of the local authority, property owners and frontagers, to the laying of additional lines and sidings."

3. "The arrangement of speed on both single and double lines of track, so as not to impede the ordinary passenger-car service."

4. "The inauguration of the system."

An appendix to the printed paper contains a considerable amount of information on the "Goods Traffic of the Rheinische Railway Co., Dusseldorf."

The discussion was opened by the CHAIRMAN who remarked that tramways should work in close connection with the railways and supply distributing centres, whence vans could be employed to take goods, especially parcels, &c., to their final destinations. The scheme suggested by Mr. Gibbings would be very complicated to organise in respect of running powers on the lines of different authorities.

Mr. GEORGE HILL said he would welcome gladly the introduction of such a scheme as the author's, but thought it would be some time yet before it could be made to work satisfactorily.

Mr. LINDLEY thought that the system could be made to pay if served by distributing and collecting agents who, with their vans, would call on people and collect goods and deliver them in truck-loads to the tramways just as they at present serve the railways. Also if lower rates were established than are now in vogue the trade would come of itself. Goods traffic would be very detrimental to the passenger traffic, and therefore the former ought to be dealt with at night.

Mr. TWINBERROW said the greatest difficulties to be met were the objections of people, over, or in the vicinity of, whose property it was proposed to carry the goods. Engineers should go very carefully indeed into the whole question, and know exactly what they wanted before trying to get any powers.

A few other members present took part in the discussion, and Mr. GIBBINGS replied briefly.

A vote of thanks to the author, proposed by Mr. H. A. EARLE, was seconded by Mr. DOUGLAS, and heartily carried.

The list of the gentlemen appointed on the committee, &c., for next session was read out and included the names of Mr. E. W. Cowan as chairman and Mr. C. W. Taite as vice-chairman. Mr. Earle then announced that the present session was at an end.

ROYAL COMMISSION ON LONDON TRAFFIC.

THE Royal Commission on London Locomotion resumed its sittings at the Westminster Palace Hotel on Friday under the chairmanship of Sir David Barbour.

Mr. W. H. DICKINSON gave evidence on behalf of the London County Council, and said he was chairman of the Special Committee on Locomotion, which was appointed for the purpose of placing before the Royal Commission the views of the London County Council. That Special Committee was considering the whole question of locomotion in London with a view to placing before the Commission all the information in the Council's possession, and later on would empower witness and various officers of the Council to give such evidence. At present, however, he proposed to restrict his evidence to the question of the establishment and powers of a special tribunal. The question of the necessity for some such controlling authority was not a new one, but had been considered many years ago. Witness proceeded to refer to the proceedings before the Select Committee of the House of Lords on London Railways in 1863; the Joint Select Committee on Railway Schemes of both Houses of Parliament appointed in 1864; and the Joint Select Committee on the question of the future railways of Central London in 1892. He put in a table showing the schemes for underground railways sanctioned between 1892 and 1901. From this it appeared that 22 such schemes had been sanctioned and six had not been begun. A further table was put in dealing with the various tube Bills which had been suspended this session by Parliament. As to the suggestions of the Council with regard to the constitution and powers of the proposed tribunal, the resolutions passed by the Council's Special Committee on Locomotion were as follows:—

1. That a permanent tribunal be established (*a*) to consider all tube or other railway schemes of a local character which may be proposed; (*b*) to consider and suggest alternative schemes, or extensions of such schemes, so as to bring all schemes into conformity with some uniform and comprehensive plan of transit throughout London, and (*c*) with power to issue provisional orders to be subject to confirmation by Parliament.

2. That the tribunal do consist of five members.

3. That before arriving at a decision with regard to any scheme, the tribunal be required to hold an inquiry, at which the London County Council shall be entitled to be present and be heard.

4. That the tribunal be required to give special consideration to financial questions arising on schemes before them, with a view to securing due economy in capitalisation and in the carrying out of undertakings

5. That the tribunal be empowered to require promoters, as a condition precedent to the sanctioning of any scheme or undertaking, to submit proposals for such modifications or extensions of such scheme or undertaking as in the opinion of the tribunal are necessary.

6 That the tribunal be empowered to insert clauses in provisional orders—(*a*) to secure the proper carrying out of works in the interests of public safety and convenience; (*b*) to authorise the compulsory acquisition of land under the Lands Clauses Consolidation Act, 1845, and grant exemptions as to—(1) acquiring easements only; (2) acquiring parts only of property; (3) taking subsoil under public streets without payment; (*c*) to fix a period for the commencement and completion of an undertaking; (*d*) to provide for the payment of compensation in respect of damage resulting from the construction or working of an undertaking; (*e*) to provide for inter-communication; (*f*) to provide for suitable accommodation for passengers and an adequate service of trains; (*g*) to fix rates and fares and to provide for revision of the same (including those fixed by existing Acts); (*h*) to require promoters of a scheme to make a deposit, and to provide for the time of making and the application of the deposit; (*i*) to regulate the issue and raising of capital, and to provide for the limitation of dividends; (*j*) to give local authorities an option to purchase an undertaking at the expiration of a given period; (*k*) to generally limit and define the terms and conditions upon which an undertaking should be authorised.

7. That the tribunal be empowered, after an inquiry and upon the application of a public authority or public authorities, to issue a provisional order or orders revising the terms and conditions under which an undertaking is worked, or requiring further facilities to meet public requirements to be provided, and to submit such order or orders to Parliament for confirmation.

8. That the powers of the London County Council as the local tramways authority shall not come within the jurisdiction of the tribunal; the Council being recognised as the sole authority for the construction of all tramways, whether surface or underground, in London, and retaining its present power to promote Bills dealing with the same without being obliged to obtain the consent of the road authorities to the introduction of such Bills.

Asked by the CHAIRMAN why they excluded tramways from the tribunal, witness said the County Council had always asked for a tribunal for tube railways but they had not asked for a tribunal for tramways, because they did not believe there was any necessity for it. The tramways of London were now practically in the hands of the L.C.C., and so far as the improvement of the system went, he did not think they could have any better system than the present one. In the case of the tramways, the Council went to Parliament, and being the only body who could construct tramways in the county, except private companies, whom Parliament had not allowed to come in, there was continuity of promoters.

The CHAIRMAN: These arguments go to show that there are not strong grounds for referring to a special tribunal tramway matters as there are with regard to electric tube railways, but it seems to me it might be still more convenient for the special tribunal to take the tramways as well as the railways. Is there any good reason why it should not deal with tramways if it deals with tube railways?

WITNESS said that would depend on what the powers of the tribunal were. The County Council did not propose that the tribunal should have final powers. If the tribunal was to have final powers the County Council would strongly resist being placed under that tribunal. They proposed a tribunal to co-ordinate the various schemes and not to have the final powers of authorising them. He did not think there was any necessity for that co-ordination in respect of tramways promoted by the local representative authority.

But don't you think that there is the same necessity for some co-ordination not only between railways, but between tramways and railways?—I think the object of the Council is to get the best accommodation for the public and to do its best to arrange the traffic so that it would be in close communication with the railways. If it were clearly defined that the County Council was to be the only tramway authority, I do not know that there would be any objection to going to a tribunal.

Sir JOSEPH DIMSDALE: The County Council is not the road authority?—No.

And this recommendation is to take away the existing rights of the local authorities, and hand them over to the County Council so far as tramways are concerned?

WITNESS said their proposal was very definite with regard to that—that the power of veto which the local authorities had should be abolished. At present, however good a tramway might be for London generally, any local authority could refuse its sanction to the line passing through its district, and the Council had no means of putting its proposals before any tribunal whatever. This had resulted in the absolute blocking of a number of schemes. There was no doubt that the veto of the local authorities was used for obtaining money from promoters, and an instance was afforded in the case of the London United Electric Tramways. With regard to street widenings, the Council had laid down a rule that one-third of the cost should be borne by the Council, one-third by the tramway account, and the other third by the local authority. The demand on the local authority to pay one-third had provoked opposition on the part of the local authorities, and in the case of Hammersmith the London United Tramway Co. made a promise to carry out large widenings at their own cost. The local authority

preferred the money, and gave its consent to the London United Tramway Co., but would not give its consent to the Council's schemes. Under the Tramway Act the Council had also a veto, and used it, so the company could not get its proposals through.

The CHAIRMAN: Your contention is, that you should own and control all the tramways in London?—Yes; we do own them now, with the exception of a small piece of the London United Tramway's line, and in a few years we shall own the whole.

If the right of veto were removed, it might be that private companies would get in?—Yes; and that is what we want to prevent.

Replying to Sir J. WOLFE BARRY, WITNESS said that before the L.C.C. came into existence, it was a common thing for local authorities to see how much they could squeeze out of the tramway companies. The Council did not own the tramways in East Ham and West Ham, and it was true that they could not deal with the whole problem, but he thought they would have no difficulty in making arrangements with the outside bodies.

The Commission adjourned.

ELECTRICAL POWER ON RAILWAYS.

[FROM OUR LEGAL CONTRIBUTOR.]

AMONGST the Bills which have been laid before Parliament in the course of the present session, that which has been drafted by the President of the Board of Trade for the purpose of facilitating the introduction and use of electrical power on railways is by no means the least important. The discovery that electrical power can with economy be substituted for that which is now in vogue has naturally induced some of the larger companies to make experiments. In order to carry out such experiments, it would in the ordinary course of things have been necessary for them to apply to Parliament for additional powers. The measure under discussion confers a boon upon the railway companies, inasmuch as it dispenses with the necessity of any application to Parliament for additional powers. Sec. 1 provides that with the object of facilitating the introduction and use of electrical power on railways, the Board of Trade may make orders for all or any of the following purposes, namely:—(*a*) Authorising a railway company to use electricity in addition to or in substitution for any other motive power, and for any other purpose; (*b*) authorising the company to construct and maintain generating stations or other electrical works on any land belonging to the company; (*c*) authorising agreements between the company and any body corporate or other person for the supply to the company of electrical power or the supply to or use by the company of any electrical plant or equipment. [NOTE.—This clause would enable a railway company to enter into negotiations with a power company which might be authorised to supply electricity on a large scale.]

(*d*) Sanctioning any modification of any working agreement, so far as the modification is agreed to between the parties thereto, and is consequential on the introduction or use of electrical power; (*e*) authorising the company to subscribe to any electrical undertaking which will facilitate the supply of electricity to the company. [NOTE.—By this important clause the Board of Trade would probably be able to sanction a scheme by which a railway company might propose to take shares in, or otherwise give financial support to, a power supply company.]

(*f*) Securing the safety of the public.

(*g*) Authorising the issue of new capital by the company for any of the purposes of this Act.

(*h*) Any other matters, whether similar to the above or not, which may be considered ancillary to the objects of the order, or expedient for carrying those objects into effect.

An order made in accordance with the provisions above mentioned is to have effect as if enacted by Parliament.

As electrical power could not be produced on a sufficiently large scale without the construction of generating stations, the Bill further provides (by Sec. 2) that an order made under it may contain provisions authorising the acquisition of land by any railway company for the purpose of constructing generating stations or other electrical works. In case, however, the order gives the company power to acquire land otherwise than by agreement, it must not come into operation so far as it gives that power until it is confirmed by Parliament. The Board of Trade may bring in a Bill for obtaining the necessary confirmation.

An order made under the proposed Act may contain provisions:—

(*a*) For the revision of the scale of passenger fares to be charged by the company; and

(*b*) For requiring the company and any other company owning or working railways or tramways communicating with the lines of the company, or having a terminus or station near a terminus or station of the company to afford additional traffic facilities to the public by means of through booking or otherwise; and

(*c*) For modifying any working agreement to which the company are a party, although the modification is not agreed to by the other parties. The order, however, so far as it is made for any of those purposes, shall be subject to appeal to the Railway Commission within the time limited by rules under the Act at the instance of any company affected thereby, and so far as appealed against, shall not come into operation unless confirmed by the Railway Commission.

The Board of Trade are to have power (by Sec. 4) to hold a local inquiry with a view to considering any application for an order under the Act, and the Board of Trade Arbitration Act, 1874, is to apply to any such inquiry in the same manner as if (*a*) the same were held on an application made in pursuance of the special Act; and (*b*) the parties making the application for the order, and any person objecting to any such application, were parties to the application within the meaning of Sec. 3 of that Act.

There underlies this measure, a principle of the first importance to the progress of electricity. We refer to the principle which recognises that the Board of Trade is competent to decide many questions in relation to the adoption of electricity as a means of distributing energy, without the intervention of Parliament. Another principle is also recognised in the Bill. The Railway and Canal Commissioners have long existed as a tribunal for the settlement of the questions which arise between railway companies and those of the public who use the railways. They have been able to decide an infinity of minor questions which could not in the nature of things have been settled by the insertion of clauses and public or private Acts of Parliament. At present there is no tribunal set apart for the special consideration of the numerous questions which arise from time to time in relation to the supply of electricity. The proposed measure suggests that certain matters in relation to the use of electricity on railways may be laid before the Commissioners. We should be glad if these questions, together with others arising in connection with the supply of electric light, could be referred to some special tribunal, which might ensure the uniform administration of electric lighting law throughout the country.

NOTES ON MOTOR-STARTING SWITCHES: A CRITICISM.

BY FRANK BROADBENT, M.I.E.E.

"IN view of the growing importance of electric motive power, it is surprising that the accessories of the electric motor have so seldom been brought forward for discussion before the engineering societies." So says Mr. A. H. Bate in the opening sentence in his paper, bearing the above title, read before the Birmingham Local Section of the Inst. E.E. on the 29th ult.

Having read the paper, and found nothing that is new, and little that is interesting, one comes with a feeling of disappointment to the peroration: "In conclusion, let me say that in these brief notes no attempt has been made to treat the subject systematically, or as a whole, but rather to mention a few points of interest that have cropped up from time to time in selecting starters for different purposes; leaving a more adequate treatment to those who are directly concerned in the manufacture of this class of switch, to whom by right it belongs."

Would that this paragraph had been the opening rather than the closing one.

Whilst giving credit to Continental and American makers for improvements made from time to time in starting switches, the author cites as novel points in English-made switches, features that have been common to the American types for many years.

In comparing the various types, viz., the open coil, the sand box and the liquid types, the author is neither very convincing nor conclusive. To say that "when properly rated, the absorption type will stand overloads for a short time just as well as the radiation type" is particularly inconclusive, and is no more than saying one thing is as good as another, when each is specially designed for a particular duty. The embedded resistance—that is, the "absorption type"—was surely brought out as an improvement on the open-coil type. By embedding the resistance wire in sand, cement, or enamel, a wire of considerably smaller section may be used than would be possible with an air-cooled arrangement.

Such wires may, and frequently do, become red-hot without setting up any fire risks, and would stand overloads which would burn out an open-coil resistance.

But this is only one side of the picture. There are other aspects of the question. Makers have been working for years to discover a cement or enamel that would give high insulation resistance, that would not peel off or crack with a sudden overload, and that would not act injuriously on the resistance wire. The great objection to the embedded resistance is the practical impossibility of repairing it, and until an absolutely indestructible one is brought out, the open-coil type will be preferred. An objection to the sand-box type is the liability of the resistance wire to decentralise when

the box is fixed on a machine on which there is considerable vibration. In this way the resistance may become earthed to the metal case.

Among the "radiation" types, no mention is made in the paper of the cast-iron grid form of resistance, a type of resistance which may be run at a red heat without endangering it.

The author appears to consider slow starting, limiting the current on the first and successive steps to definite amounts and the interlocking of a double-pole switch with the starting lever, to be unnecessary, but in later portions of his paper he supplies the arguments in favour of these precautions. Thus in speaking of a particular make of liquid switch, it is claimed as a virtue that the current cannot be turned on suddenly, and that the initial current in the case of a 10-H.P. starter does not exceed 5 to 10 amperes. Presumably a 500-volt motor is here referred to.

In discussing the methods of connecting up switches, the author does not appear to be in touch with what is, and has been for years, very common practice. "The majority of makers," we read, "arrange their switches for the armature to be connected to the last contact of the resistance. The main is then joined to the starting lever, and the shunt magnet is connected through the 'no volt' coil to the first contact of resistance. The current is applied simultaneously to the magnets and armature, so that as the field builds the torque is applied gradually. Moving the switch lever over cuts the resistance out of the armature circuit and puts it into the field circuit." So far, so good; but a little later we are led to believe that it is something of a novelty that, in a recent form of switch, the starting resistance is cut out of the shunt circuit, when the switch is in the full "on" position.

It is further given as a "unique feature of this starter that the spring pulls the switch lever to the 'full on' position, instead of to the 'off' position as usual."

To put it very mildly indeed, these features are neither novel nor unique.

The above description of the starting operation, supplies the argument for a slow movement, which the author of the paper apparently considers unnecessary. If the motor gets its full current on the first step, before the field has built up, it is just a question of whether the operator pushes on the starting handle more quickly than the field builds up, which determines the maximum current taken by the motor. Suppose a man to be inching a printing machine round, he will push the switch half over in a second, so cutting out considerably more than half the resistance before the field gets a chance or the armature moves.

An overload cut-out, which merely short circuits the no-volt release, is of no use under these circumstances, as the man can hold the switch on. If the overload acts on a separate lever, the operator will soon find a means of preventing it working, as it would break his circuit each time he tried to move his machine. This is only one little instance of many that might be cited. What, for example, will happen in starting a centrifugal machine, a heavy line of shafting, or any machine with considerable inertia, unless either the resistance is sufficient to limit the rush of current on the first few segments, or some slow-starting gear provided?

But an alternative method is described, viz., "to connect the armature to the starting lever, and to join both the main and the shunt magnet wires to the last, or 'full on,' contact of the resistance. The field is then excited when the main switch is closed, and the motor is started and stopped without demagnetising the magnets. When the lever touches the first contact the full torque is instantly applied to the armature, and this causes undue strains on the moving parts."

This description is a little obscure, and in any case is not the usual method of connecting up when the shunt is excited by means of the D.P. switch.

If "full torque suddenly applied" unduly strains the moving parts, is not the remedy to increase the resistance and limit the initial current to, say, half the full load current, or even less in some cases? But, in a previous paragraph, the author considers that the "full load current for the start" is "quite good enough for any properly constructed motor." Then, again, how is the motor started and stopped, without demagnetising the field? The D.P. switch referred to is provided for the purpose of stopping the motor; when the starter will automatically come off, *after the shunt has discharged through the armature*, not before.

A man has no right to stop a motor by means of the starter if a D.P. switch is provided for the purpose. This is just how the contacts get burnt, and the starter is condemned in consequence. The condition, therefore, described in the succeeding paragraph of the paper, in which the starter is "off" and the D.P. switch "on," ought never to exist, except just prior to starting up, and here Mr. Bate supplies the argument for interlocking the two.

The D.P. switch ought always to be opened first; and here, again, is a serious defect in the automatic starter described at the end of the paper. The paper is disappointing, and the author has not done himself justice nor taken full advantage of his opportunity of discussing fully the practical considerations involved, not in the *manufacture*, but in the operation of starters.

INDEPENDENT AIR PUMPS AND CONDENSERS.

By W. H. BOOTH.

There are undoubted advantages in independent condensing sets. They can be connected to any one of several engines if it should appear of advantage that this should be possible. They can be of the best design and proportion for their work, and this is a matter of some difficulty where the air pump is directly driven off the engine. In most engines the air pump dimensions are fixed once for all, and it may be they are too large or too small. Should the engine be lightly loaded, the air pump has less air to deal with. The air is liable to be cooler also, yet the direct-driven pump continues to generate the same volume as when the engine is fully loaded.

When an independently-driven air pump is employed, its speed may be regulated exactly to what is necessary. If the vacuum falls the pump may be speeded up to improve it. If the vacuum is high, the pump may be run slower until the vacuum falls slightly. Some engineers are of opinion that any vacuum better than 24 or 26 in. of mercury is obtained at too great a cost of air pump driving.

In this power of varying the air pump speed, nevertheless, lies the chief disadvantage of the separate set. Young engineers are exceedingly perfunctory in their behaviour towards condensing plant. They look upon the air pump as a pump for air, and take good care to supply plenty of air for it to remove. The air pump is certainly intended to remove air, but it is only intended to remove a certain irreducible minimum, and with surface condensation this minimum should, obviously, be very small indeed. As a fact, it is usually very large, and when an engine is shut down and all valves and cocks about it are closed, the vacuum gauge on the condenser falls rapidly to zero, whereas it should not fall below 24 in. in the course of an hour. This is a practical possibility. In theory it should never disappear, but it is excellent and exceptional practice which can show a 24-in. "vacuum" after an hour's stoppage. If anything like this can be shown, the air-pump is not being saddled with much unnecessary work, and should easily maintain a working vacuum of 26 to 28 in. If, however, the vacuum does not hold up well in the stopped engine, it may be bad to run the air-pump fast enough to maintain 24 in. Now this is what many engineers persist in doing. They have a vacuum which will not hold up well when the engine and air-pump are stopped, but they keep it up to 22 or 26 in. by driving the air-pump at an excessive speed, with great waste of power. This is where the independent air-pump appears at fault. By its means a poor vacuum is made as good as possible by furious running of the pump instead of by searching for and stopping leaks in injection and exhaust pipes, at glands and cocks, and many other weak spots in the chain. When the pump is driven off the engine it can never be run beyond its designed speed, the vacuum drops in response to an air leakage, and cannot be improved except by stopping the air leak.

The atmospheric exhaust valve is one of the worst

offenders in air leakage, and ought to be provided with a few inches of water seal and a gauge glass to show that the seal is there.

In the production of a vacuum it should be remembered that the fulness of this depends upon the clearance of the air pump, so that it is most important that there should be no air pockets on the suction side of the pump in which air can expand and contract alternately, or such pockets may very seriously reduce the efficiency of the pump. One rarely sees an independent condensing set run as slowly as it should be capable of running with efficiency. To run such pumps properly the air tightness of the whole plant should be assured to a high degree of permanance as above noted, and the air pump should then be run to give, say, 26 in. Under exceptional circumstances as regard cold water supply a higher vacuum may be obtained. The engineer should then endeavour to determine the value of an extra inch or two inches of vacuum. He may count the revolutions of the pump engine necessary to give each extra inch. One inch of vacuum may be calculated as half a pound pressure on the low pressure piston and the additional power calculated.

Assuming this additional percentage of power to save its percentage of the total steam, this must be equated with the air pump steam consumption, and the gain or loss may thus be found. The proper condenser temperature may also form a proper subject of investigation. Condenser temperatures are always found to be lower than the temperature proper to the vacuum when this is not being spoiled by air leakage. It is no use cooling the exhaust too low, for this may mean colder feed-water, and it also points to more condensation of steam in the cylinder. The injection-water requires to be cut down until the vacuum begins to get worse, for it costs in air-pump steam to remove the excess of water, or in circulating-pump steam in case of surface condensers. If a vacuum of 26 in. is aimed at, it may be kept at that point if things are tight by two expedients. Either the temperature may be kept low, which will render the air pump more efficient, or the air pump may be run fast enough to draw out the hotter air if the water be cut down. The value of the air-pump steam, which corresponds with a 10° difference of temperature for equal vacuum, may be calculated fairly approximately and equated with the observed feed temperature value represented by this initial advantage of 10°. Every point about a condensing plant is a compromise, and the whole ought to be so airtight that in surface condensation the vacuum keeps good with ease, and does not when the condenser is fairly cool demand extravagant running of the air pump.

THE ELECTRICAL POSSIBILITIES OF A COAL MINE.

It is not often that the outside public hears of the Birmingham Association of Mechanical Engineers, but it is quite a lively little Association, and the papers presented by its members are occasionally of considerable merit. By far the best of recent papers is that on "The Mechanical Engineering of Modern Collieries," read by Mr. W. Bardill, on February 7th.

After reading that paper one feels more than ever that there is an enormous field still to be opened to the electrical engineer and all his works. Very perfect steam engines—so far as a steam engine can be perfect—are found in large collieries, but there is an entirely insignificant number of motors in use for any purpose as yet.

Assuming that the average reader of the REVIEW has but a superficial knowledge of the intricacies of coal mining, a paper such as Mr. Bardill's widens his perspective vastly; for there it is borne in on one that the getting of coal does not consist merely in letting a man down a shaft with a pick to knock off lumps, which he loads into a cage at intervals. That kind of working hardly squares with outputs of 2,000 to 3,000 tons from one shaft in one working day of 9 to 10 hours.

In 1860 the coal raised in the United Kingdom amounted to 80 million tons. 40 years later, in 1900, the output reached 225 million tons, and this increase is due very much more to increased all-round efficiency than to any increase in the number of pits. In so brief a period as twenty years the maximum output from one shaft has increased from under 500 tons per diem to probably over 3,000 tons per diem. For instance, one pair of engines, as a double cylinder engine is called, at the Bolsover colliery made a record wind of 3,207 tons of coal in 10½ hours, from a depth of 445 yds., the winding being done at the rate of about 30 m.p.h. It is not any "slouch" of an engine which does duty of that description, and one's sympathies are really all with the manager who has conscientious objections to scrapping such a plant in favour of a soulless motor with no majesty of motion, or mighty connecting rod. With practically no exceptions, winding engines are coupled direct to the drum, as in the days of the beam, and it may be that there is some difficulty in persuading people to take to gearing, which appears to be offered as a rule with a motor wind. Presumably there are instances of electrical winding in Great Britain, but none are mentioned by Mr. Bardill. That they are wanted is plain from the statement that nearly all winding engines are non-condensing, that compounding has been found wanting, and that automatic cut-off and expansion gears have been introduced in a few modern collieries, but do not seem to find much favour even where they have been tried.

Then follows a paragraph which so endorses a leaderette in the REVIEW of April 17th, that it is worth extracting:—"Generally the mine manager looks at the matter (of economy) as of little moment, as he has always at his command a lot of fuel he can hardly sell or give away, and he uses his boilers much as a borough engineer uses his refuse destructors, *i.e.*, not so much for its calorific value as its convenience for destroying a nuisance. . . . . At present the difficulty of finding a market for small coal is acute, and I saw at a colliery only the other day 20 10-ton wagons of small coal, which had passed through a ½-in. mesh, which the manager told me he could not sell at 9d. per ton."

Probably 5 per cent is a small figure for the proportion of small coal in the annual output of Great Britain, but 5 per cent. of the 1900 output, if used as it might be used, would yield at least 450 million units per annum, which would drive all the mechanical plant of all the collieries in the country.

Before the coal gets within range of the winding engine, it has been hauled distances varying from a few hundred yards to several miles. Much of this work is done by ponies, which are often treated barbarously, but important collieries are equipped with some form, or forms, of mechanical haulage, generally of the endless rope or the tail rope varieties.

The endless rope worked by surface engines is used chiefly in the Midlands. In the South Wales district the tail rope system is popular, chiefly operated by means of a large number of small compressed air engines, while in Lancashire, Yorkshire, and the North, we find a combination of the two systems, worked by steam, oil, compressed air, or electricity, and the author thinks that before long electricity will be used almost exclusively for this purpose, although its adoption is not by any means general as yet.

Little 5-B.H.P. motors hauling from the working face to the main haulage road are superseding two or three horses, and doing 50 per cent. more work in a much superior fashion. One has only to think of the enormous area covered by a large colliery with its many miles of roads, to remember that the traction problem is as complicated as in a large town, and the energy required is very large. It may be that, as the trolley car has superseded the horse-car and cable-car above ground, so the electric locomotive will reign supreme below, and not only below either, for much use will be found for it on the surface railways which often extend for miles about a colliery.

In the many collieries unfortunate enough to be troubled with water, the electrical engineer will find a large and ideal load. In S. Staffs., for instance, the areas covered by the Midland Electric Power Co., and by the Mines Drainage Commissioners, are largely coincident, and, although it is difficult to obtain sufficient detailed information, we are led to believe that the Mines Drainage Commissioners have actually broken ground with a scheme for unwatering 40 million tons of coal by means of isolated electrically-driven pumps supplied with energy from the mains of the Midland

Electric Power Co. It is probable that these pumps will be easily moved from place to place as required, and will be practically automatic in action.

To give the reader an idea of the extent of these pumping operations, a few figures quoted from the paper before us will serve. A Birmingham firm of steam pump makers 10 years ago supplied to a Northumberland colliery a plant to force 80,000 gallons per hour to a height of 360 feet. At Manton, two sets of engines are at work dealing with a permanent "feeder" of four million gallons per 24 hours. At the Clock Face colliery, plant to deal with six million gallons per 24 hours is being installed.

The same firm have installed electrically-driven pumps, raising 5,500 gallons per hour against a head of 1,680 feet; 12,000 gallons per hour against 500 feet, and 10,000 gallons per hour against 1,500 feet.

There are hundreds of collieries, mostly of the smaller kind, where pumping is performed by engines built in the 18th century, and one cannot but think that persistent energy, backed by intelligence, should in time have its reward in the conversion of the most conversative of the mine owners to electric pumping, at least, if the mains of a supply company are within a reasonable distance.

Just as important as pumping is the question of ventilation, and here again is work for which nothing is more suitable than electricity; no new problems are involved, although the actual problem of fan design is still to be solved.

Doubtless, there are many other openings for the motor in colliery work, but what has been said should be sufficient to remind any who need reminding that the increase in the demand for electric power must not be allowed to diminish while there remains a colliery proprietor who has not found grace.

THE MOSELY INDUSTRIAL COMMISSION.

Having been deeply impressed, as a business man and a traveller, with the way in which the United States is becoming one of the most important industrial nations of the world, Mr. Mosely decided last year to invite the Secretaries of the Trades Unions representing the principal industries of the United Kingdom, to accompany him on a tour of investigation into the industrial situation across the Atlantic. Accordingly, a party of 23 men left England last October with Mr. Mosely, some going first to Canada, the others directly to New York; and afterwards, alone or in company, under the auspices of the National Civic Federation of New York, the delegates studied the conditions of labour and employment each in the trade of which he was the more or less accredited agent. Every man was allowed to go to any centre he wished, no date being fixed for the return of the party. Mr. Mosely states that every facility was afforded by American masters and men for their visitors to acquire information, permission being given for private conversation with the employés, and, except in one or two instances, all departments of the factories being exposed to view. Hospitality was somewhat lavish, and perhaps interfered with the work; but, says Mr. Mosely, elliptically and suggestively, "some" of the delegates "were exceedingly studious and evidently bent more on work than pleasure." On the return of the party, about the end of last year, each member was requested to write a report upon what he had seen and heard, and also to answer a list of 41 identical questions. Only one of the delegates failed to perform his obvious duty in this particular (reasons for his abstention being omitted); and accordingly the published report of the Commission, now before us, is a bulky volume of 280 large pages, containing 22 reports and the same number of replies to the set questions, as well as a preface by Mr. Mosely himself. On studying the report carefully, one cannot but be struck with the fact that at least a large proportion of the delegates worked hard in the States, thoroughly examining, so far as the time at their disposal permitted, the position of working men in America, from the pecuniary, technical, and social aspects, and collecting impressions as to the mutual relationship existing between employers and employed. Several of the writers exhibit a distinct tendency to be discursive in their reports, which are reproduced verbatim so far as they deal with matters properly coming under their purview, and with subjects upon which they should be qualified to express expert opinions; but in a few instances it has seemed difficult to keep the writers to the point even when replying to the set questions.

Nevertheless the document is of deep interest and considerable value, if only as the average verdict passed by the British working man upon his American rival. It is perhaps fair to remember that the delegates represent only (or mainly) the organised branch of each department of handicraft, and that they are, probably, examples of the most progressive, most enlightened English workmen—men who should naturally tend to ascribe to the employer as many of the causes as possible of those which in their opinion, or in that of others, are making for any decreasing prosperity in British industry. There was also a temptation in the States for the delegates to receive, and preferentially to accept, invitations to inspect the largest, most modern, and best equipped workshops of America; it being left rather to the diligence and honour of each individual delegate to search out the smaller and older places, so as to guard himself against receiving an unfairly optimistic view. On the whole, however, there should not be, and does not appear to be, any particular bias evident in the reports; but to whatever extent it exists, it must naturally be in favour of the British workman as a workman, probably in favour of the American employer, and of the American workman as a citizen, possibly against the American workman as a workman, and inevitably against the British employer.

Coming now to the substance of the volume before us, and combining together the gist of the reports and the answers to the questions, we find that the matters dealt with concern (*a*) the early training of the worker; (*b*) the relations between employers and employed; (*c*) the general condition of workers outside the factory; and (*d*) general questions about the merits of the American Civic Federation. Most of the delegates are agreed that the American lad receives a better education than the English boy; but they vary in their opinions as to whether it is the elementary or the secondary or the technical education which surpasses ours. All remark that the value of education is more realised by adults there than here. With the exception of Mr. Deller (Plasterers), who "does not think so," and Mr. Cummings (Boiler Makers and Iron Shipbuilders), who finds that the American workman "is sober during working hours, yet is as much inclined to a spree as the ordinary Britisher," all the delegates aver that the American is much more sober. Mr. Mosely himself says that the true born American is "infinitely more sober." Mr. Deller again says that "gambling is general," and Mr. Cummings that "gambling and pleasure-seeking appear to be characteristic of the American's life"; but all the other writers say that betting upon horse-racing, &c., is much less common, or even practically unknown among the workmen of the States. Mr. Mosely holds that the American is more energetic than the Briton; but the general view of the delegates appears to be that he does not work any harder, though some say he worries more (? interests himself more) over his work. He produces more in a day, occasionally because of longer hours, which are now frequently being shortened in the States; but generally because hand labour has given way to machinery wherever possible, and because that machinery is run at a higher speed than obtains with us. Thus, in many trades the American workman becomes a mere machine minder, or so narrow a specialist that he can only perform one or two single operations in his trade; unlike the Briton, he is often unable to make a finished article by himself from the raw material and a drawing. The American workman takes much higher wages than the Englishman—from 20 or 40 per cent. more to 100 per cent. more and upwards, measured in money. The sheer necessaries of life, such as food, cheap clothing, &c., cost practically the same on both sides of the Atlantic; rent, however, is much higher in the States, and luxuries, good clothes and the like, are dearer. Nevertheless, making allowance for this, the American receives higher wages measured in terms of purchasing power, the figures given by the delegates varying from 10 per cent. to 60 per cent. (rough average, 30 per cent.) more. Mr. Flynn (Tailors) strikes a discordant note: he says the wages are 100 per cent. more in money, 50 per cent. *less* in value. Mr. Mosely

himself considers the American to be better housed, better fed, and better clothed than the Englishman; but Mr. Steadman, representing the Trades Union Parliamentary Committee rather than any particular industry, admits only the better feeding. Most of the delegates agree that the workman of the States is in a position to save more money than the Briton; but they usually shirk the question whether he actually does so. The question was asked whether the American workman "wears out" more quickly than the Briton. Those of the replies which are explicit are in the ratio 10 : 7 that he does not. Some delegates remarked the absence of old men from the shops, but others pointed out that the universal habit of clean-shaving makes an elderly American workman look younger than he is. Mr. Mosely, whose vote may be added to the majority, affirms that the American is healthier than the Englishman, and cogently argues that if his working life is shorter, it is because his higher wages and more temperate habits enable him to save enough money to retire upon. In general the delegates admit that a smaller proportion of old American workmen become dependent upon public support; and unless the somewhat intimate question whether they are maintained in old age by friends and relatives can be answered by an emphatic affirmative (which it is not in the report) the seven minority delegates would appear to have made a mistake.

All are agreed that the American employer is far more accessible to his men than is the case in Great Britain, where control of the shops is so often left to the foreman. Men are encouraged to make suggestions for the improvement of the process in which they are engaged, and in many cases employés doing so are rewarded by an increase in salary or an early promotion. In some establishments each man is given a number known only to himself and the chief; he makes his suggestions in writing, signed only with his number, and puts them in a special box, which is opened at intervals. This arrangement prevents the foremen from knowing who offers the suggestions, and thus avoids any danger of the man being snubbed or even sacked (as several delegates say happens in this country) if the intermediate officers are jealous or fearful of supersession. The identical system of numbers is occasionally employed in the creation of a private record of a man's past behaviour and services, so that a valuable servant may not be dismissed for one single lapse without sufficient cause. Opinions are somewhat fairly divided as to whether the American workman requires and receives more or less "overlooking," as to whether he is more or less ready to exert himself unusually in times of special pressure, and as to whether he does his best to give a fair day's work for a fair day's pay. These last questions appear to have annoyed some of the delegates, who reply sharply in a manner indicating their satisfaction with the Briton; and this, perhaps unjustly, suggests that the American is rather a better servant in these respects. All agree that the American workman has better opportunities for rising in the world and the shop than the Englishman.

A question whether sanitation, ventilation, and comfort were more attended to in the States than here, was answered in the affirmative by 10 delegates, in the negative by 5, 6 considering matters fairly balanced. Mr. Barnes (Engineers) states very emphatically that excepting a few shops he mentions by name, the American places were dirtier, more insanitary, more congested, but better heated in winter and cooled in summer. Ten delegates said the American factories were better equipped, three denied it; nine said they were better managed, four denied it; one said they turned out better work often (Cox, Iron and Steel Workers), 17 denied it—those not included in the list either finding no difference, or omitting to answer the questions plainly.

The trades with which we are mainly concerned were represented by Messrs. Walls (Blast Furnacemen), Maddison (Ironfounders), Cox (Iron and Steel Workers), Barnes (Engineers), and Cummings (Boilermakers). Most of their general views have been included in the foregoing; but certain statements in their special reports are worth attention. Walls says that in America, men at the blast furnace are not subjected to the same physical exhaustion as here, owing to the use of labour-saving appliances. There is no casting in the sand. The skilled labour of the furnace is mostly "British," the unskilled labour mostly that of short, weak Italians, with some Poles and Scandinavians. Per 24 hours the men take the same money in the North of England as in the States; but including the Midlands and South Wales, the Yankee gets 40 to 60 per cent. more. The average output of an American blast furnace is more than double that of an English one; but half of those in America belong to the old pattern, and less than half are charged with elevators. Maddison, and especially Cox, require to be read in the original, as their reports are long, and contain descriptions of some of the chief works visited. Cox quotes Mr. Wm. Garrett as saying: "Your average English workman can work anywhere with equal results given equal facilities. There are with very few exceptions no workmen in the world so expert, or who can stand so much, as the English workman. Treat your workmen like men instead of machines, utilise their brains, encourage suggestions, lessen the distance between the manager and his men, and the result will be beneficial to both." It is Cox alone who holds that better work is done in American factories than here; but he is referring to such places as Vandergrift, and he is careful to insist that the reason lies in the inferiority of our plant, not in that of our workmen. Cox entirely disbelieves the alleged "scrapping" of old men in the States; he has seen men of 50, 60, and in one case of 72, at the rolls. On the other hand, youth is no barrier to promotion. The men who work the hardest are the manager, superintendent, engineers, and foremen. Barnes's report is also far too full of detail to be usefully abstracted by itself. He considers the English system of apprenticeship training is the better of the two, but there are several exceptions, as at Brown & Sharpe's and Hoe's. At the former, a special man is engaged by the firm to look after the apprentices' interests, and to see that they are moved from one machine to another. At Hoe's, if a lad prefers to stop on any particular machine, he is paid $1 per week above the usual rate for the rest of his term. Barnes quotes the average age at death of machinists and blacksmiths in the States at 50¼ years, whereas the average in the case of the A.S.E. is 52 years. The difference he ascribes partly to the unhealthy mode of living, as well as to the prolonged daily strain. The American eats too much, takes less outdoor recreation, and enjoys less social home life than the Briton.

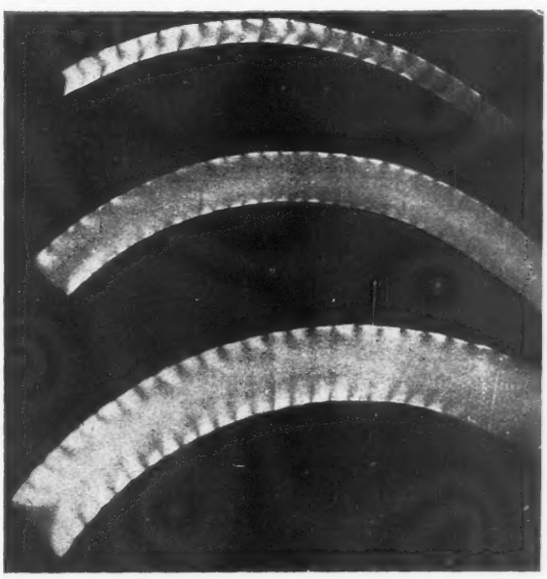
Mr. Mosely's own summing up of the report is by no means the least useful and interesting feature. Mr. Mosely considers that the average American is more capable of using his brains than the British workman; but many of the men holding leading positions are either English or Scotch, while the true born American is proud of his British descent. Labour-saving machinery is used everywhere, is encouraged by the unions, and welcomed by the men. It saves the workman enormous manual exertion, raises his wages, tends towards a higher standard of life, and rather creates work than reduces the number of hands employed. Mr. Mosely holds that the American workman ably assists his employer to "run the machinery for all it is worth;" but he does not consider that men in general do so here. In England the rule has been for generations to cut down a man's rate of pay when he earns more than a certain sum of money. In the United States the employers rather welcome large personal earnings as long as they themselves can make a profit, for they see that the machines and the men occupy the same space in the factory, and so represent the same capital, whether they do much or little. Fuel and raw materials cost about the same there and here, but facilities for transport, both on land and water, are undoubtedly better and cheaper in the States. The streets are not so clean, but rates are lower, and Mr. Mosely would like to see some of our money diverted from local purposes and put to education. In the future this would cause the workman's wages to be higher, and would eventually enable him to contribute something to rates.

Cardiff.—The Asylum Committee of the T.C. on April 30th decided to have the new asylum lit by electricity supplied by the Corporation. The South Wales Power Distribution Co. had offered to supply 225,000 units per annum at 1½d. per unit, equal to £1,406 5s, but it was estimated that if the Corporation generated its own current it would only cost £706 per year, leaving £700 to meet interest and loan charges on plant laid down.

OSCILLATORY ELECTRIC SPARKS.

By C. J. WATSON.

The annexed photograph is one of spark discharges from a 20-plate condenser, having 22 ft. of coated surface. The discharge was made oscillatory by passing it though $\frac{1}{4}$ mile of insulated wire, made into a coil, with its layers further insulated by many sheets of paraffined paper. The spark was about $\frac{1}{4}$ in. long, and was focussed by a lantern or portrait lens, on to a circular rapid plate of 3 in. diameter, which was fixed on the end of an electric motor making about 40 turns per second, the plate rotating in its own plane. The measured time of a complete oscillation is $\frac{1}{3000}$ second, which is approximately the period calculated from the constants of the condenser and coil, and the total time of discharge never varies much from $\frac{1}{200}$ second. The best results have been obtained by fixing a piece of magnesium



riband on the spark terminals, and it is found that they frequently show a slight alternation of the brightness of the electrodes with the direction of the oscillation, though not so markedly as those given in Righi's recent book. It will also be noticed that the space between the electrodes does not appear to light up until some time after the discharge passes, and naturally the heated vapour remains luminous for a short time after the discharge has ceased. The condenser was charged by a fine motor-driven Wimshurst, which was kindly granted me by the Birmingham Natural History and Philosophical Society for investigations on electric waves.

Even when using only two jars of about a gallon capacity in all, I have obtained distinct pictures of oscillations, and also with these fed by a 2-in. induction coil, when the spark is much shorter, but in return each discharge may consist of several sparks.

PROF. J. J. THOMSON ON RADIUM.

Prof. J. J. Thomson, the discoverer of the corpuscle or electron, has entered the field with an explanation of the mystery of radium. In an article of the highest interest, in *Nature*, April 30th, he discusses and demolishes some of the explanations that have already been offered, and shows that the phenomena of radio-activity, as far as they are known, all point to the conclusion that the radiant energy is derived from changes taking place inside the atom itself.

Sir William Crookes, as we have already explained (Electrical Review, p. 682), believes that the energy of radium is derived from the surrounding air. The radium is supposed to have the property of absorbing the energy of the high-speed molecules of the air, and thus raising its temperature above that of the surrounding air. Prof. J. J. Thomson fails to see that even the possession of this property would explain the behaviour of radium; "for imagine," he says, "a portion of radium placed in a cavity in a block of ice; the ice around the radium gets melted; where does the energy for this come from? By the hypothesis, there is no change in the energy of the air-radium system in the cavity, for the energy gained by the radium is lost by the air, while heat cannot flow into the cavity from the outside, for the melted ice around the cavity is hotter than the ice surrounding it."

Another theory, favoured by M. Curie, the discoverer of the energy of radium, is that radium has the property of absorbing some kind of Becquerel radiation constantly flowing in surrounding space. That some kind of highly penetrative radiation is being continually emitted from the earth's surface has been recently demonstrated by McClennan and Burton (Elec. Rev., p. 746). Experience has shown that Becquerel radiation is most readily absorbed by substances of high atomic weight, and the high atomic weight (225) of radium is in favour of the view that radium would be a powerful absorbent of the radiation. But many other substances, such as gold, platinum, and lead have atomic weights nearly as high as radium, they are strong absorbers of Becquerel radiation, and yet none of them are strongly radio-active.

It appears, therefore, that all the theories hitherto put forward to show that radium derives its perennial supply of energy from external sources, are unsatisfactory. We are now driven to seek for the source of energy in changes taking place in the atom itself. Assuming that the atom of radium is made up of pairs of positive and negative corpuscles held together by electric attraction, J. J. Thomson has calculated that the expenditure of 1 per cent. of this energy would be sufficient to supply the flow of energy measured by M. Curie.

It is necessary, however, to find a determining cause for the liberation of this sub-atomic energy, and herein consists the most ingenious part of J. J. Thomson's theory. It is the high-speed atoms which become unstable and radiate part of their internal energy into space. It is believed by physicists that the velocities of the molecules of solids and liquids, like those of gases, are continually changing, owing to collisions. The mean velocity remains the same at constant temperatures, but the velocities of single molecules are continually rising above and falling below the mean. Thomson assumes that the internal constitution of the atom may become unstable when it attains a velocity, say, 100 times the mean velocity. Under these circumstances the atom becomes partially disintegrated, and throws off the positive and negative electrons which are known to be emitted by radium. The percentage of the total number of atoms which attain this high velocity, and become unstable, is always very small, but the number is sufficient to maintain the energy emitted by radium for 30,000 years if we assume that each atom loses only 1 per cent. of its intrinsic energy.

The known phenomena of radio-activity fit in very well with this theory. Becquerel has shown that the radio-active element can be separated from uranium by precipitation, and Rutherford has shown that the active element of thorium, which he calls thorium X, can be precipitated by ammonia. Now uranium X, and thorium X, gradually lose their radio-activity, and the uranium and thorium which have lost their radio-activity by precipitation, gradually recover it again. What happens, according to Thomson's theory, is obvious. The precipitate carries down all the atoms whose speed is so high that they are in the unstable condition. In course of time these atoms radiate off the energy derived from their internal changes and lose their radio-activity. The original substances, in the meantime, are acquiring, by the inter-action of their atoms, a fresh supply of high-speed atoms in an unstable condition, and thus recover their original radio-activity. The steady state of radio-activity is reached when the emission of energy is equal to that capable of being supplied by the number of atoms which attain the critical velocity.

The demons of Clerk-Maxwell were imagined to show

how the temperature of a gas might be raised by merely opening the doors for the high-speed molecules. If the theory of Prof. J. J. Thomson is correct, we have the high velocities themselves acting automatically to pull the trigger and liberate amounts of energy sufficient to permanently raise the temperature of surrounding bodies.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

8,883. "An improved circuit-breaking fuse." H. L Dixon. April 20th.

8,900. "Improvements in apparatus for the production of galvanic deposits." E. Muller. April 20th. (Complete.)

8,917. "Luminous electric apparatus for advertising and the like." B. J. B. Mills. (L. Touchebeuf, France.) April 20th.

8,950. "Improvements in electrical stop motions for drawing frames." J. Cross and N. M. Loftus. April 21st.

8,964. "Improvements in electric batteries." S. Yai. April 21st. (Complete.)

8,971. "Electric curling iron." M. Shepherd. April 21st.

8,975. "An improved electric sign." A. M. W. Lehfeldt. April 21st.

8,990. "Improvements in apparatus for arranging and displaying telephonic addresses and for such like uses." A. V. Hunt. April 21st.

"Improvements in electrically-driven clocks, workmen's time recorders, costing machines, and the like." P. Macmaster. April 21st.

9,015. "Improvements in electrical generators for producing alternating currents of low frequency." Siemens Bros & Co. (Siemens & Halske Aktien-Gesellschaft, Germany.) April 21st. (Complete.)

9,029. "An improved suspended electric incandescent lamp." M. H. Galsworthy and The London Electrical Fittings Co., Ltd. April 21st. (Complete.)

9,088. "Improvements in contact-makers for electrical recording turn-stiles." A. Marsh. April 22nd.

9,115. "Improvements in trolleys for electric railway cars on the overhead system." W. A. Daggett. April 22nd. (Complete.) Date applied for under Patents Act, 1901, April 22nd, 1902, being date of application in United States.

9,121. "Improvements in voltaic cells." M. E. Conrad. April 22nd.

9,126. "Improvements in measuring electrical energy." W. E. Evans. (Allgemeine Elektricitäts Gesellschaft, Germany.) April 22nd. (Complete.)

9,131 "Improvements in plug and socket connections and switches for electrical purposes." G. M. Sellick. April 22nd.

6,135. "Improvements in and (or) connected with electro-motors of the induction type." F. M. Lewis. April 22nd.

9,149. "Improvements in or relating to electric trolley protectors." H. Birkbeck. (The Electric and Steam Railway Supply Co., U.S.) April 22nd. (Complete.)

9,150. "An improved mercury contact making and breaking device." G. C. Fricker. April 22nd.

9,173. "Improved metal clamp applicable for the supporting standards and brackets of overhead electric wires and other purposes." C. Naylor and J. Naylor. April 23rd.

9,206. "Improvements in method of and apparatus for transforming electrical energy." P. C. Hewitt. April 23rd. (Complete.) (Date applied for under Patents Act, 1901, April 25th, 1902, being date of application in United States.)

9,207. "Improvements in electric traction vehicles." S. Bash. April 23rd.

9,231. "Improvements relating to electric telegraphy." S. G. Brown. April 23rd.

9,249. "Improvements in electric storage batteries." E. Bailey and T. Whiteley. April 24th.

9,251. "Improved support for electric glow lamps." G. Davis. April 24th.

9,259. "Improvements in and relating to the ventilation of enclosed dynamos or motors." I. Holmes and A. Denby Smith. April 24th.

9,264. "Improvements in electrically heated hand tools or implements." R. Haynes. April 24th.

9,304. "Improvements in dynamo-electric machines." J. G. Bell. April 24th.

9,305. "Improvements in electric ignition apparatus for internal combustion engines." A. J. Postans. April 24th.

9,311. "Alternating current meter." A. M. Clark. (Hartmann & Braun, Germany.) April 24th.

9,316. "Improvements in or relating to arc lamps." A. Blondel. (Date applied for under Patents Act, 1901, April 24th, 1902, being date of application in Belgium.) April 24th. (Complete.)

9,324. "Improvements in electro-magnets and armatures therefor." I. H. Parsons. April 24th.

9,331. "A new or improved system for automatically controlling the voltage of electric generators." W. S. J. A. Jones. April 24th.

9,351. "An improved method of converting mechanical energy into electro-motive force." R. Lewis and G. Meek. April 25th.

9,353. "Improvements in and connected with shade holders for electric lamps." G. Birch. April 25th. (Complete.)

9,364. "Improvements in or connected with insulators for electrical conductors." A. Brier. April 25th.

9,372. "Improvements in insulators applicable to overhead tramway wires." J. A. Penny. April 25th. (Complete.)

9,388. "Improvements in receivers for use in wireless signalling." H. H. Jack. (De Forest Wireless Telegraph Co., United States.) April 25th.

9,390. "Improved manufacture of accumulator plates or grids." J von der Poppenburg. April 25th.

9,408. "Improvements in and relating to apparatus for the transmission of electrical energy." A. Artom. April 25th. (Complete.)

9,409. "Improvements in lifeguards for electric cars and other self-propelled vehicles." A. Royle. April 25th.

9,411. "Improvements in pull-down devices for the trolley poles of electric cars." J. Mawdsley. April 25th.

9,420. "Improvements in or relating to electrolytes for secondary batteries or accumulators." W. Peto and J. W. T. Cadett. April 25th.

9,425. "Improvements in and relating to fuses." G. M. Hathaway and C. F. Hathaway. April 25th. (Complete.)

PUBLISHED SPECIFICATIONS, 1901.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

23,090. "Improvements in or relating to apparatus for automatically switching electric current on or off, turning gas or water on or off, and the like." J. J. Stockall. Dated November 14th.

23,098. "Improvements in or in connection with electric arc lamps." F. W. Branson. Dated November 14th.

23,047. "Improvements in means for adjusting the conductor in conduits of electric tramways on the slot conduit system." W. A. Heindle. Dated November 14th.

23,114. "Improvements in controllers for electric motors." F. C. Newell. (Date applied for under Section 103 of Patents, &c., Act, 1883, April 18th.) Dated November 15th.

23,115. "Improvements in windings for electrical machines." B. G. Lamme. (Date applied for under Section 103 of Patents, &c., Act, 1883, April 17th.) Dated November 15th.

23,116. "Improvements relating to the regulation and distribution of electric currents." B. G. Lamme. (Date applied for under Section 103 of Patents, &c., Act, 1883, April 17th.) Dated November 15th.

23,131. "Improvements in or connected with conduits for electric railways and tramways." G. F. M. Cornwallis-West. Dated November 15th.

23,153. "Improvements in or connected with electrical demand or rebate indicators." A. Wright and Reason Manufacturing Co. Dated November 15th.

23,166. "Improved devices for use in electric wiring." J. A. Robertson. Dated November 16th.

23,214. "Improved manufacture of a material for incandescent electric lamp filaments." Siemens Bros. & Co. (Siemens & Halske, Aktiengesellschaft.) Dated November 16th.

23,215. "Improvements in electrical accumulators." V. Cheval and J. Lindeman. (Date applied for under Section 103 of Patents, &c. Act, 1883, April 22nd.) Dated November 16th.

23,225. "Improvements connected with enclosed or open electric arc lamps." L. C. H. Mensing. Dated November 16th.

23,261. "Automatic switch for switching off an electric motor used for pumping purposes." M. G. Drake and Drake & Gorham. Dated November 18th.

23,294. "Improvements in earth conductors for lightning conductors." P. Immich. Dated November 18th.

23,312. "Improvements in insulating gloves for use in electrical or chemical operations." G. E. Heyl-Dia. Dated November 18th.

23,376. "Improvements in electric fuse boxes." British Thomson-Houston Co. (T. van Aller.) Dated November 19th.

23,377. "Improvements in electric fuse boxes." British Thomson-Houston Co. (R. H. Read.) Dated November 19th.

23,378. "Improvements in electric arc lamps." British Thomson-Houston Co. (R. Fleming.) Dated November 19th.

23,379. "Improvements in electric current transformers." British Thomson-Houston Co. (W. S. Moody.) Dated November 19th.

23,380. "Improvements in electric fans." British Thomson-Houston Co. (J. J. Wood.) Dated November 19th.

23,398. "Improvements in the equipment of electrically-propelled cars." Siemens Bros. & Co. (F. Lydall.) Dated November 19th.

23,399. "Improvements in the equipment of electrically-propelled cars." Siemens Bros. & Co. (F. Lydall.) Dated November 19th.

23,400. "Improvements in the equipment of electrically-propelled cars." Siemens Bros. & Co. (F. Lydall.) Dated November 19th.

23,401. "An improvement in the controllers of electrically-propelled cars." Siemens Bros. & Co. (F. Lydall.) Dated November 19th.

23,423. "Improvements in and relating to means for supporting and insulating the trolley wires of electric tramways on the overhead trolley wire system." W. C. Ullmann and A. E. Barber. Dated November 19th.

23,429. "Improved system of electrical propulsion for railway and other cars." W. P. Thompson. (G. J. Scott, W. S. Janney and F. le Bar.) Dated November 19th.

23,456. "Improvements in and relating to electrical resistances." H. A. Mavor and Mavor & Coulson. Dated November 19th.

23,600. "Improvements in shunts for electrical measuring instruments." A. Eckstein and F. Panter. Dated November 21st.

23,637. "Improvements in electro-magnetic couplings." O. Imray. (J. H. L. Onken.) Dated November 21st.

23,659. "Improvements in hoisters for suspended electric lamps." O. Graetzer. Dated November 21st.

23,668. "Improvements in street fender boxes or disconnecting pillar boxes for electric traction, electric lighting or electric power purposes." J. A. Fletcher and S. Fletcher. Dated November 21st.

23,682. "A staff or ticket system for controlling traffic on railways during fog or otherwise." S. Catchpole. Dated November 22nd.

23,722. "Improvements in electric testing instruments." British Thomson-Houston Co. (T. F. Mullaney.) Dated November 22nd.

23,738. "Improvements in magnetisable bodies for use in telegraphones." P. O. Pedersen. Dated November 22nd.

23,756. "An improvement in mechanical and electric current." L. Joseph. Dated November 22nd.

23,804. "Improvements in electric motor systems." British Thomson-Houston Co. (G. O. Baker.) Dated November 23rd.

23,805. "Improvements in electric circuit breakers." British Thomson-Houston Co. (C. C. Badeau.) Dated November 23rd.

23,806. "Improvements in systems of electric motor control and pneumatic apparatus therefor." British Thomson-Houston Co. (W. B. Potter.) Dated November 23rd.

23,838. "Improvements in or connected with telephone systems." I. H. Parsons. (G. W. Green.) Dated November 23rd.

23,897. "Improvements in controlling traffic on single lines of railway and apparatus for that purpose." E. Tyer. Dated November 25th.

23,915. "A new or improved method and means for securing electric incandescent lamps to service wires." W. R. Lambert. Dated November 25th.

23,934. "Improvement in and relating to automatic electric switches and like apparatus." G. Charlton and W. E. Barton. Dated November 25th.

24,011. "Improvements in electrical apparatus including telephone and like apparatus." P. M. Justice. (C. C. Barton.) Dated November 26th.

24,012. "Improvements in or relating to compound insulating material for electrical purposes." R. W. James. (Mica Insulator Co.) Dated November 26th.

24,027. "Improvements in machines for dividing textile fabrics into required widths." F. T. Mumford. Dated November 26th.

24,052. "Improvements in globes or shades for incandescent electric lights." J. C. Fleming. Dated November 26th.

24,054. "Improvements in resistances for arc lamps and other electrical apparatus." J. L. Davies. Dated November 26th.

24,095. "Improvements in house service terminal boxes." S. W. Baynes. Dated November 27th.

24,134. "Improvements relating to electrical connections." J. G. Accles F. H. de Veulle. Dated November 27th.

24,175. "Improvements in conduits for laying electric cables." H. N. Brooke. Dated November 28th.